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THE OVERALL OBJECTIVES OF THIS SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN (SHERP) ARE TO:

1. ENSURE THAT SAFE WORKING CONDITIONS EXIST AT THE SITE DURING ALL ASPECTS OF THE WORK
2. IDENTIFY EMERGENCY PROCEDURES TO FOLLOW SHOULD THE NEED ARISE.

THE SHERP DISCUSSES THE FOLLOWING:

1. RESPONSIBILITIES OF ALL PERSONNEL INVOLVED IN THE PROJECT
2. ENVIRONMENTAL, HEALTH, AND SAFETY PROGRAM STANDARDS THAT WILL BE ENFORCED
3. PROGRAM REQUIREMENTS
4. OCCUPATIONAL MONITORING
5. PERSONAL PROTECTION
6. DECONTAMINATION
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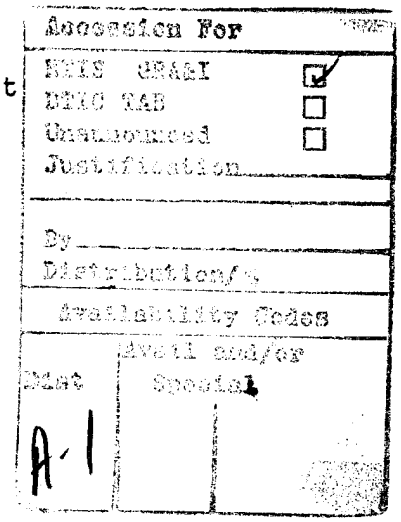
SAFETY, HEALTH AND EMERGENCY RESPONSE PLAN
PHASE I SITE INVESTIGATION AND ANALYSIS
BASIN F GROUND WATER TREATMENT INTERIM RESPONSE ACTION
ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO

Prepared for:

Department of the Army
Corps of Engineers, Omaha District
Contract Number DACW45-88-D-008



Prepared by:

IT Corporation
Project Number 301159.01.01

Prepared by Karan North — Date: 6/29/88
Health and Safety Coordinator

Approved by [signature] — Date: 6/28/88
Project Manager

Approved by Willard A. Prugh II — Date: 6/28/88
Project Director

Approved by _____ — Date: _____
Army Corps of Engineers

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1.0 INTRODUCTION

1.1 INTRODUCTION

IT Corporation (IT) is to perform the Phase I Site Investigation and Analysis for the Basin F Ground Water Treatment Interim Response Action at the Rocky Mountain Arsenal under contract with the Department of the Army, Corps of Engineers (COE). The objective of Phase I is to perform a site investigation which includes geotechnical drilling and sampling, monitoring well installation and slug testing. This Safety, Health and Emergency Response Plan (SHERP) has been prepared to specifically address the site investigation and analysis.

All work performed by IT will be performed in accordance with applicable federal, state, local and internal regulations. Specifically, these include the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), requirements of 29 CFR 1910 and 29 CFR 1926, the United States Environmental Protection Agency (EPA) requirements, IT's Corporate Safety policies and procedures manual (9000 series), the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities" (NIOSH 85-115), and applicable COE requirements. The following procedures have been developed to comply with the above mentioned regulations.

Reasonable precautions will be taken by IT to ensure protection of the health and safety of the workers, the general public, and the environment. Evidence of compliance will be provided, as applicable, by the monitoring records generated from the Health and Safety (H&S) program.

All personnel that are included as part of the field investigation work at the RMA will be required to read, understand and comply with the provisions of this SHERP and are required to sign the consent form found in Appendix A.

1.2 PURPOSE/OBJECTIVE

The overall objective of this SHERP is to ensure that safe working conditions exist at the site during all aspects of the work and to identify emergency procedures to follow should the need arise. The safety organization and procedures have been established based on knowledge of potential site-specific

hazards as presented to us by the COE. Necessary personnel protection measures will be selected in response to these risks.

The SHERP establishes the organization and responsibilities of all personnel involved in the project in addition to establishing the environmental, health and safety program standards that will be enforced. It also outlines the program requirements, occupational monitoring and personal protective methods that will be utilized during Phase I field work at the RMA.

An emergency response plan has been developed specifically to address the field investigation to be conducted at the RMA. Environmental and hazard control monitoring will also be performed as described in the plan.

1.3 GENERAL HAZARD DESCRIPTION

The SHERP identifies specific hazards associated with contaminated material and wastes at the RMA. These hazards are, in part, specified by identifying the chemicals that could possibly be expected to be present at the project site. Data previously generated by Clayton Environmental Consultants, Inc. (Clayton), Environmental Sciences and Engineering and RMA have been incorporated and are presented in Table 1. This table includes the suspected chemical contaminants that may be encountered during Phase I. Until individual contaminants are known through subsequent investigations not to exist, it will be assumed that any of these constituents could be encountered during field activities.

1.4 SITE DESCRIPTION AND LOCATION

The Rocky Mountain Arsenal is located in Adams County, Colorado, adjacent to the community of Commerce City. The geotechnical study area lies within the north half of Section 26, and the south half of Section 23, Township 2 South, Range 67 West (Figure 1).

In the 44-year history of RMA, many hazardous chemicals have been manufactured, stored, or partially destroyed in demilitarization activities. Key compounds include GB and VX nerve agents, H and L blister agents, BZ incapacitating agent, munitions, organophosphorus pesticides and herbicides, phosgene, hydrazine, and toxic heavy metals.

1.5 HAZARD EVALUATION

Soil-boring activities are potentially hazardous because they may release significant organic vapors and bring contaminated water and soil to the surface.

1.5.1 Chemical Hazards

Table 1 lists ground water and soil contaminants previously detected at the RMA. Included are the Threshold Limit Values (TLV) for the compounds, the toxicity rating, hazards and concentrations of the contaminants found in soil, air, and water at the RMA.

Material Safety Data Sheets (MSDS) for the chemicals used on site and for many of the contaminants listed in Table 1 are included in Appendix B. The NOISH/OSHA Occupational Health Guidelines for Chemical Hazards are intended to provide information on chemical use in occupational settings. Particular attention should be directed to the health hazard information, chemical and physical properties, and emergency first-aid sections.

Additional information on the contaminants listed is given in the Agent Fact Sheet, SHCRM Form 357 (RMA 1984) and Military Chemistry and Chemical Agents, TM 3.215 and AFM 355.7 (Department of the Army and Air Force 1963). Copies of this information will be available at the support trailer at RMA.

1.5.2 Physical Hazards

Typical site hazards may include slippery ground, uneven terrain, and heavy equipment. Ways to avoid such physical hazards are outlined in Section 6 of this plan.

2.0 ORGANIZATION AND RESPONSIBILITIES

2.1 PROJECT STAFFING AND LINES OF AUTHORITY

2.1.1 General

All operations which treat, excavate, drill, trench, handle, sample, dispose of, or otherwise pose the potential for an exposure to site specific contaminated material are governed by this SHERP.

Personnel are responsible for continuous adherence to safety procedures during all field work activities. In no case may work be performed in a manner that conflicts with the intent of, or the inherent safety and environmental cautions expressed in these procedures. After due warnings, personnel violating safety precautions and procedures will be dismissed from the site and potentially terminated. All field personnel will be properly trained in health and safety regulations associated with working with hazardous materials and waste, the proper handling and storage procedures associated with this material, and safe operation practices of all equipment used on site. Resumes for all outlined personnel are found at the end of this section.

2.1.2 Corporate Industrial Hygienist (IH)

An Industrial Hygienist may be consulted prior to the commencement of field activities. The IH will be responsible for:

- Technical assistance to the Environmental, Health and Safety Officer (EHSO);
- Technical coordination and guidance for the H&S program;
- Technical guidance regarding information on medical programs;
- Technical guidance regarding toxicology and exposure limits of known contaminants;
- Technical guidance regarding hazard assessment, personal protective equipment and respiratory equipment requirements;
- Employee training requirements;
- Technical assistance regarding the personnel monitoring;
- Responsible for appraisal of new environmental, health and safety regulations.

2.1.3 Site Environmental, Health and Safety Officer (EHSO)

The EHSO is responsible to ensure that the Project Manager is implementing all H&S procedures/policies during daily field activities. The EHSO will be the liaison on matters relating to environmental, and health and safety concerns for both the COE and regulatory agencies.

The EHSO is responsible for the H&S of all workers and ensuring that environmental releases do not affect the H&S of the general public. The EHSO will be properly trained and have adequate equipment and staff as needed to ensure that all work is done as safely as possible.

The EHSO will also be responsible for:

- Conducting a review of all proposed activities prior to commencement, evaluating potential hazards and recording the appropriate information;
- Being notified and available when work activities are being performed in areas requiring decontamination of personnel or equipment;
- Advising the COE and IT's Field Manager of potential health and safety hazards during site investigation activities;
- Conducting or having an acceptable alternate to conduct special monitoring if necessary;
- Evaluating potential modifications to work plans and personal protective equipment requirements to ensure employee safety;
- Assuring all involved persons are properly trained in the appropriate safety procedures, have current medical certification that they are physically capable to wear respiratory equipment and that they are physically fit to perform required tasks;
- Maintaining all required documents, records, and reports;
- Contacting the appropriate local emergency organization to coordinate emergency response activities;
- Performing safety inspections, both regularly scheduled and unannounced;
- Acting on employee concerns in accordance with procedures outlined in this plan;
- Considering variations of prescribed H&S standards, and the timing and manner of correction.

- Assisting the Project Manager in enforcing disciplinary action for willful violation, refusal, or failure to correct violations of H&S standards or regulations;
- Ensuring that information regarding H&S matters is recorded and reported for all employees;
- Ensuring that operations cease when a safety/environmental condition is uncertain or poses a risk to human health and/or the environment, and requesting assistance from the appropriate safety personnel;
- Presenting environmental, safety, and health training to employees;
- The complete implementation of the HSP.

The EHSO for this project is Karan North.

2.1.4 Project Manager

The Project Manager is ultimately responsible for ensuring that this plan is implemented and that all project participants abide by requirements set forth in this plan. This includes communicating site requirements to field personnel, COE personnel, and consultation with the EHSO regarding appropriate changes to the SHERP. The Project Manager for this project is Gary Cantrell.

2.1.5 Field Manager

The Field Manager is responsible for field implementation of the SHERP. This person is directly responsible for ensuring that all field personnel comply with applicable requirements. Responsibilities include:

- Communicating specific requirements to all field personnel;
- Auditing health and safety practices in the field;
- Consulting with the EHSO;
- Submitting requests for variances from the requirements of this plan to the EHSO;
- Implementing familiar emergency response activities, procedures and notification requirements;
- Assisting the EHSO in monitoring the performance of employees involved in the field investigation to ensure compliance with H&S requirements;
- Terminating work activities if unsafe conditions develop or when directed to do so by the EHSO.

The Field Manager is Joe Tyburski.

2.1.6 Remedial Investigation Staff

Individuals with appropriate training and experience designated by the EHSO will be responsible for day-to-day H&S concerns when the EHSO is not on site. Workers on this project will:

- Know and understand applicable SHERP requirements;
- Obtain guidance from the Field Manager, supervisor, or EHSO in the event that any uncertainty about safety arises;
- Comply in full with all safety requirements.

2.1.7 Occupational Physician

The occupational physician that will be used for occupational exposure and medical consultations on this project will be:

Dr. Rupurt C. Burtan, M.D.
1660 South Albion Street #700
Denver, Colorado 80222
(303) 768-1482

GARY N. CANTRELL

Professional Qualifications

Mr. Cantrell has been involved with the management of projects requiring ground water monitoring, siting of evaporation/tailings ponds, and remediation and closure of hazardous waste sites. He has over 12 years of experience in general civil, geotechnical, and construction engineering. He has considerable experience in investigating, designing and constructing numerous projects including treatment plants, locks and dams, sewer systems, bridges, irrigation systems, and major buildings. He also has considerable experience with numerous foundation systems, cofferdams, dewatering, erosion protection, and design of hydraulic structures.

Education

Ph.D., (complete except dissertation), Civil Engineering (Geotechnical), Purdue University, West Lafayette, Indiana; 1982-1985

M.S., Civil Engineering (Geotechnical), Purdue University, West Lafayette, Indiana; 1978

B.S., Civil Engineering, University of Illinois, Urbana, Illinois; 1969

Experience and Background

1986 - Present — Senior Project Engineer, IT Corporation, Denver Colorado. Responsible for ground water monitoring program and site selection study for evaporation/tailings ponds. Certifying cleanup and closure of hazardous waste site.

1985 - 1986 — Project Manager, Rocky Mountain Geotechnical Inc., Colorado Springs, Colorado. Served as Project Manager or Senior Engineer on numerous large land development projects including investigation, design and construction control on foundations, embankments, drainage, road subgrades, etc.

1982 - 1985 — Graduate Research Assistant, Purdue University, West Lafayette, Indiana. Teaching assistant for undergraduate and graduate level courses in civil engineering. Research assistant on a national science foundation sponsored research project addressing liquifaction of soil deposits. Used state-of-the-art in situ testing techniques to assess soil conditions.

1979 - 1982 — District Manager, Vice President, ATEC Associates, Inc., Denver, Colorado. Total responsibility for establishing the Denver office of a national firm offering services in geotechnical engineering, materials testing and inspection, and contract drilling. Developed the operations into a 15-20 person office. Negotiated and directed testing and inspection services on numerous projects including large sewer systems, work at Highlands Ranch and the Colony oil shale project, airport runways and a 30 story high-rise building.

1974 - 1979 Geotechnical Engineer, CH2M Hill, Denver, Colorado/Portland, Oregon
Broad range of activities in the geotechnical and general civil areas of a large multi-disciplined firm. Preparation of proposals, planning and directing site investigations, laboratory testing, engineering analysis and design, preparation of project plans and specification, and construction inspection. Work included investigation design and construction engineering on water treatment plants, seepage control systems, canal systems, hydraulic systems and large sewer systems.

1974 Assistant Project Manager, American Lakes Development Company, Sublet, Illinois. Numerous responsibilities on a 1500-acre land development project. Purchasing materials, scheduling and supervising subcontractors, and liason between sales force and property owners.

1970 - 1974 Engineer/Office Manager, A&H Engineering Corporation. Assignments at a number of locations with a national organization providing services in the areas of geotechnical engineering, material testing and inspection and contract drilling. Technical and managerial positions including Division Manager of two offices with responsibility for the total operations and direction of up to 18 employees. Provided construction quality control services on one of the largest pile-driving contracts ever awarded, high-rise buildings, two nuclear power plants, and a large tunnel project.

1969 - 1970 Civil Engineer, Dravo Corporation, Eastern Construction Division, Pittsburgh, Pennsylvania. Performed quantity take-offs and secondary design in the home office on cofferdams, bridge piers and other heavy construction. Field engineer for construction of a water intake for Mobay Chemical Company on the Ohio River and West Virginia. Various assignments on a Corps of Engineers lock and dam in Alabama. Survey control and layout for concrete in the lock and dam and for the earthwork on the approaches, levys, etc. Control Station Engineer - responsible for all aspects of the station including drawing lift sketches, checking out form work, obtaining and coordinating subcontractors, and checking their submittals and progress. Cost Engineer - responsible for job cost records, invoices, pay estimates, CPM schedule revisions, and final pay quantities.

Registrations/Certifications

Professional Engineer: Colorado, New York

Professional Affiliations

American Society of Civil Engineers
National Society of Professional Engineers
International Society of Soil Mechanics and Foundation Engineers

KARAN S. NORTH

Professional Qualifications

Ms. North has been involved in the environmental and occupational health and safety field for the past ten years, with concentration on hazardous waste permitting, management and site personnel monitoring. She is a Certified Hazardous Materials Manager; as such she has been responsible for environmental and OSHA compliance and performed both safety and environmental audits for several types of industrial operations. She has also worked directly with clients regarding permit preparation and has developed programs to ensure compliance with governing regulations and permit requirements. Ms. North has a strong background in dealing with regulatory agencies on permit issues; specifically RCRA, NPDES, TSCA and NESHAPs in addition to DOT and OSHA requirements. She is very familiar with regulations governing permitting incineration of hazardous waste in addition to the acceptance, onsite management and shipment of both hazardous and toxic materials and waste. She has also developed and presented health and safety training courses and plans in compliance with RCRA, CERCLA and OSHA requriements.

Education

B.A. Environmental Earth Science, Eastern Connecticut State College, Willimantic, CT; 1979
Radiation Protection, Georgia Institute of Technology, Atlanta, GA; 1981
Fundamentals of Industrial Hygiene, Colorado Safety Association
Fundamentals of Industrial Safety, Colorado Safety Association
Several courses/seminars on environmental regulations, Asbestos, NESHAPs hazardous waste management, DOT regulations, OSHA regulations, Health and Safety seminars

Experience and Background

1987 - Present <u>Environmental Project Engineer; Health and Safety Coordinator Corporation, Denver Colorado</u>.

- Responsible for permitting activities and agency liaison under RCRA, TSCA, OSHA, and NPDES.
- Responsible for the management of hazardous materials and waste.
- In-house consultant on environmental regulations and issues.
- Regulatory coordinator for IT-Denver's storage tank program.
- Conduct site assessment investigations (including soil, water and air) to determine present and future environmental liabilities.
- Conduct Asbestos inspections and develop associated management plan.

- Responsible for developing Health and Safety plans, on site compliance and inspections, training and accident investigation.
- Consultant regarding SARA Title II.
- Review of field activities and develop Health and Safety field procedures and monitoring requirments for level of protection to be used
- Perform and oversee monitoring of personnel and environment during field activities.
- Review monitoring data and develop action based on results.
- Oversee the effectiveness of the Health and Safety program and instute necessary changes.
- Develop and present training courses as required by OSHA.

1985 - 1987 Environmental Engineer/Hazardous Materials Manager, Waste-Tech Services, Golden, Colorado.

- Responsible for project management regarding the preparation, submittal and compliance of permits for the incineration of hazardous and toxic wastes.
- Areas of permitting and regulatory compliance included both RD&D and full Part B,s under RCRA, incineration permit under TSCA, NPDES for both mobile and stationary incinerators under CWA, Air Emissions permits for incineration under NESHAPs, radiation licensing, DOT and OSHA.
- Agency liaison during permit preparation and approval procedures.
- Developed and implemented contingency plans, spill prevention and contingency plans, emergency response plans, spill cleanup procedures and hazardous materials management for PCB operations, hazardous waste sites and fluidized bed incineration facilities. Worked with communities and local agencies regarding utilizing local resources.
- Performed community relation activities related to siting and permitting hazardous waste incerators. Attended public meetings and gave presentations as appropriate.
- Responsible for project management regarding the preparation, submittal and compliance of environmental permits hazardous waste sites.

- Performed internal environmental and safety audits.
- Responsible for the acceptance, onsite inventory and management, and offsite shipment of hazardous materials and waste.
- Served as Corporate Emergency Coordinator; Environmental, Health and Safety Officer; Radiation Safety Officer; Trainer; First Aid and CPR Instructor; and CHMM.
- Responsible for the monitoring of both personnel and the site prior to startup and during operation of incineration in addition to and during other hazardous waste cleanup activities.

1983 - 1985 Environmental Engineer/Hazardous Waste Specialist, J. F. Sato and Associates, Golden, Colorado.

- Responsible for project management regarding permitting and compliance for RCRA, TSCA, FIFRA, NPDES, CWA and NEPA.
- Responsible for the cleanup and disposal of hazardous and toxic waste spills, emergency response to incidents and the coordination of remediation of these sites, developing contracts and assisting in the cleanup in accordance with all governing regulations.
- Developed field handbooks to be used when working with, sampling or disposing of hazardous and toxic materials and wastes.
- Performed environmental audits of clients operations.
- Developed spill, contingency and emergency response plans.

1981 - 1983 Environmental Engineer/Radiation Safety Officer, Cotter Corporation, Golden, Colorado.

- Areas of responsibility included applying for, obtaining, and complying with the following permits: TSCA, RCRA, NESHAP, CWA, SDWA, Radioactive Materials and Mined Land Reclamation Act.
- Responsible for maintaining a radiological safe working environment for all employees and assuring compliance with a Radioactive Materials License.
- Responsible for both personnel and environmental monitoring for a uranium mine, ore sorter and water treatment plant.

1979 - 1981 Environmental, Health and Safety Officer, Westminco, Golden, Colorado.

- Responsible for obtaining permits and assuring compliance with the following: TSCA, RCRA, NPDES, and Clean Air Act.

- Developed a comprehensive environmental monitoring program encompassing personnel, hazardous waste cleanup and disposal, air emissions and hazardous waste management.
- Responsible for training personnel in both hazardous materials management and safety practices.
- Conducted ongoing monitoring of both personnel and the environment and interpreted the data to assure compliance with governing regulations.

1978 Environmental Technician, Environmental Protection Agency, Region I, Lexington, Massachusetts.

Registration/Certifications

Certified Hazardous Waste Manager - No. 917
Asbestos Inspector and Management Planner - No. 33

Professional Affiliations

Colorado Hazardous Waste Management Society
Colorado Association of Commerce and Industry - Industrial Waste Subcommittee

JOSEPH R. TYBURSKI

Professional Qualifications

Mr. Tyburski is a professional engineer with extensive experience in field investigations and design activities related to large construction projects for nuclear power stations, surface and underground mines, building foundations, earthen structures, and tunnels.

Education

M.S., Geological Engineering, University of Missouri, Rolla, Missouri; 1982
B.S., Geology, University of Illinois, Chicago, Illinois; 1978

Experience and Background

1986 - Present

Project Engineer, IT Corporation, Albuquerque, New Mexico.
Mr. Tyburski's responsibilities range from regulatory requirement review through preliminary studies to the conceptual and advanced conceptual and final design phases. He has applied state-of-the-art methods in underground construction by conducting hydrologic, engineering, and thermomechanical analyses. Specific activities follow:

- Assisted in the development of a hydrologic model of the modified permeability zone near a shaft, trade-off studies in the selection of methods for seal emplacement, the geometric configuration and materials for the construction of barrier systems, and the field confirmation testing of seals for a nuclear waste repository (Nevada Nuclear Waste Storage Investigation).

- Developed a physical materials test plan for full-scale nuclear waste package degradation testing (Basalt Waste Isolation Project).

- Managed repository level sampling efforts for analyzing brine content of the host rock and interpreting its impact on the brine flow mechanism at the Waste Isolation Pilot Plant (WIPP).

- Coauthored an extensive monitoring plan for the WIPP project addressing the geomechanical monitoring requirements of the first panel area to receive waste at the facility. The monitoring was complicated by the need to provide instruments capable of operating remotely in a harsh brine environment for an extended period.

- Developed recommended subsurface sampling procedures and techniques to limit chemical contamination of core and fluids obtained with conventional drilling methods. Sampling recommendations were provided for anticipated drilling at the salt site for the Salt Repository Project, Office of Nuclear Waste Isolation (ONWI).

1985 - 1986 Geological Engineer, Shannon and Wilson, Inc., Seattle, Washington.

- Resident engineer during the remedial lining of four main-line railroad tunnels in Nevada. The project involved the removal of timber supports allowing relining with flexible rock bolt and shotcrete support system, and steel sets and cast-in-place concrete liners.

- Project engineer assisting in the design and coordination of an extensive soil boring and aquifer pump testing program as part of the final design phase for the Downtown Seattle Transit Tunnel Project.

- Project engineer designing shallow foundations for various civil structures. Foundations designed include: spread and continuous footings, concrete slabs, and drilled piers.

1982 - 1985 Geological Engineer with the Projects Group of Getty Mining Company, Twentymile Coal Company, Foidel Creek Mine, Colorado.

- Resident engineer supervising the technical aspects of rock core drilling and detailed testing programs to define rock mass parameters. The programs included horizontal stress determinations, strain relief, aquifer pump tests, and comprehensive laboratory strength testing.

- Participated in the underground mine design, defining pillar dimensions, opening stability, and layout orientation. Surface subsidence, slope stability, and potential hydrologic inflows were also analyzed.

- Operational responsibilities included: ore quality control, geologic mapping, hydrologic inflow monitoring, and related technical support for federal and state mine permit applications.

Joint Venture, Trinity Mine; Texas. Evaluated operating partners pre-mine exploration and engineering design activities. Programs addressed the geotechnical aspects involved in the design and development of a large open pit lignite mine.

1980 - 1982 Graduate Teaching Assistant, Department of Geological Engineering, University of Missouri-Rolla. Teaching assistant responsibile for laboratory sessions in Geological Engineering and Remote Sensing.

1978 - 1980 Assistant Geologist, Dames and Moore, Environmental and Geotechnical Consultants, Chicago, Illinois.

- Field geologist responsible for soil and rock sampling activities during the subsurface investigation of nuclear power plant sites.

- Supervised field activities involving piezometer well emplacements and aquifer testing.

- Performed the geotechnical mapping of the plant facility and empoundment structure excavations for a nuclear power station during construction. The activities supported foundation stability assessments. Lead geologist during field mapping operations of the 1980 season.

- All nuclear work was conducted to ANSI NQA-1 standards.

Registration/Certification

Certified Professional Geologist: Virginia
Professional Engineer: New Mexico

Professional Affiliations

International Society of Rock Mechanics
Association of Engineering Geologists

Publications

Deal, D. E., J. B. Case, R. M. Deshler, P. E. Drez, J. Myers, and J. R. Tyburski, 1988, "Brine Sampling and Evaluation Program, Phase II Report," DOE-2800-87-010, prepared for U.S. Department of Energy by Westinghouse Electric Corporation and IT Corporation.

Drez, P., D. Meyer, C. Cravatto, J. Tyburski, and J. Pearson, 1987, "Summary Report of Potential Methods for Salt Repository Project Geochemical Sampling, Sample Preservation, and On-Site Analysis," Final Report, August 1987, prepared for Intera Technologies, Inc.

3.0 PROJECT DESCRIPTION

The current project, Phase I Site Investigation and Analyses, Basin F Ground Water Treatment Interim Response Action, is intended to provide the preliminary geotechnical information for the proposed ground water treatment plant and to obtain further information relative to the ground water characteristics and aquifer hydrogeologic characteristics in the area.

3.1 GEOTECHNICAL INFORMATION

Geotechnical information will be obtained from 14 soil borings, each extending to a depth of 20 feet. The soil borings will be advanced utilizing hollow-stem augers. Soil samples will be obtained using standard split-spoon samplers and Shelby tube samplers as appropriate. Laboratory analyses will be performed on selected samples to classify the materials. If cohesive samples are encountered at the depths specified for Shelby tube samples, laboratory analyses will be performed to determine the strength and consolidation parameters for foundation design.

3.2 HYDROGEOLOGIC CHARACTERIZATION

To obtain information relative to the ground-water characteristics and characteristics of the aquifer in the area, six monitoring wells are to be installed. The six monitor wells will be installed through the shallow aquifer, and penetrate slightly into the underlying bedrock formation. The monitoring wells are being installed to allow sampling and analysis of the ground water to determine the ground water characteristics and to allow slug testing of the aquifer to determine the hydraulic conductivity.

Details of the field work associated with the hydrogeologic characterization are presented in the "Field Investigation Work Plan." Details on the sampling and analysis of the ground water are presented in the "Analytical Plan for Water."

3.3 WORK TO BE PERFORMED BY OTHERS

IT Corporation will install and develop the wells and perform the slug testing for estimating the aquifer conductivity. Actual sampling of the monitoring wells shall be performed by the RMA, Technical Operations Division or their

representative. Final ground water measurements (obtained at least two weeks after the last well is sampled) shall be performed by RMA or COE personnel. Removal of surficial soil shall be performed by RMA personnel prior to IT's UXO sweep. If any unexplained significant anomalies result from the UXO sweep, investigation of the anomalies will be by RMA personnel.

4.0 HEALTH AND SAFETY

Personnel working at RMA may encounter conditions that are unsafe or potentially unsafe. In addition to the danger caused by the physical, chemical, and toxicological properties of the material(s) present, other types of hazards (e.g., electricity, water, heavy equipment, falling objects, loss of balance, or tripping) could have an adverse effect on the health and safety of personnel. This section describes the requirements that will be implemented to minimize these potential adverse effects.

4.1 GENERAL OPERATING PROCEDURE

Safe operating procedures are basic fundamentals and apply to all employees of IT. These procedures are to be observed and followed at all times by all employees and subcontractors.

The following are general guidelines to be followed in the field to assure a safe working environment:

- Comply with all safety instructions. They include instructions posted on signs, given by supervisors, and those listed in the SHERP. There may be areas where conditions require the posting of special signs to control the safety of a job operation. In addition, the Field Manager may determine certain precautions necessary in addition to those normally used for a particular job;
- Horseplay is prohibited in the field;
- Alcohol or other intoxicating materials are prohibited during an operating shift;
- Wear personal protective equipment as prescribed in the SHERP for the particular job. The company has furnished certain protective equipment designed to protect employees in specific circumstances, provided the equipment is used properly. This equipment will be kept clean and properly stored to prevent damage;
- Housekeeping is very important. Keep the plant and all work areas clean and neat;
- Report all unsafe conditions to the EHSO at once;
- Every employee has the right to ask questions about instructions;
- Smoking will be allowed only within designated areas on site.

4.2 PERMISSIBLE EXPOSURE LIMITS

Conventional industrial hygiene monitoring will be conducted, where applicable, on employees and in work areas to determine the employee's atmospheric exposure to site contaminants. The types of monitoring to be utilized are discussed in Section 7 of this SHERP. The results of the monitoring will be utilized primarily for documentation purposes and will influence, among other things, the selection of the personal protective equipment. Monitoring will also be conducted adjacent to work areas to determine if dusts, vapors, fumes, mists and particulates are leaving the work area. Results of industrial hygiene monitoring and surveillance will be compared to the applicable American Conference of Governmental Industrial Hygienist (ACGIH) Threshold Limit Values (TLV). Table 1 lists the exposure limits for potential on-site airborne contaminants.

As stated earlier, Table 1 contains a list of the known contaminants. Information regarding the toxicity of these substances will be available on site, via Material Safety Data Sheets (MSDS) or other pertinent information, and will be discussed at the initial health and safety site training given by the EHSO. The EHSO or designee will be notified as soon as reasonably possible if personnel sampling results exceed the appropriate TLV or the Short Term Exposure Liability (STEL). At a minimum, a weekly summary of all sample results will be submitted to the EHSO.

4.3 BIOLOGICAL AND TOXIC EFFECTS OF ORGANIC COMPOUNDS, METALS, AND INORGANIC COMPOUNDS

The potential health effects to workers will vary depending upon the particular contaminant. As part of IT's Hazard Communication Program, workers will be provided with information and training on hazardous materials that they use or may reasonably be expected to encounter. This information will be made available to site workers through MSDS. Tailgate safety meetings will provide an opportunity to make workers aware of the dangerous or toxic properties of the materials that they may be exposed to or are working around.

IT's medical monitoring programs (Section 7) include liver function tests and a urinalysis. These tests do not include screens for specific heavy metals or organic chemicals. In cases where activities involve exposure to chemicals

that have specific OSHA medical monitoring requirements (chloromethyl ethers or arsenic for example), supplemental baseline and exit physicals may be required in order to assess employee exposures.

4.4 PROGRAM REQUIREMENTS

Some of the program requirements are discussed below. At a minimum, all COE health and safety policies and protocols, as outlined by OSHA regulations, will be followed by IT personnel.

4.4.1 Initial Site Survey

Prior to initiating the full-scale investigation, a physical walk-through inspection will be conducted by the EHSO or designee. This inspection will serve to familiarize the H&S Department with the site location and the potential hazards associated with the individual site.

Prior to initiating any work on site, the EHSO will consult COE safety and industrial safety personnel, if necessary, to assess the following conditions:

- Physical hazards of the proposed work;
- Chemical conditions expected to be present at the proposed work locations (organic and inorganic chemicals, acids, bases, oxidants, etc.);
- Contamination levels expected to be present at the proposed work locations;
- The access routes to and from exit routes from the work location.

The EHSO will supplement the RMA's and Clayton Environmental Consultant Inc.'s information with surveys as needed to complete the assessment of conditions expected to be encountered during the proposed work. The EHSO will determine, based on available information and the activities in the area, the level of protective clothing necessary to collect the supplemental information.

4.4.2 Operating Procedures

For this project, a properly completed MSDS will be supplied for substances before they are brought on site. A copy of these sheets will be kept on site in the site H&S file.

The potential for employee exposure to chemical and physical agents during normal field activities may exist. The chemicals on site that employees could potentially be exposed to have been identified in Table 1. Applicable MSDSs will be reviewed during the initial site-specific safety meeting.

4.4.3 Field Manager's Daily Safety Inspections

A daily safety inspection will be made and documented by the Field Manager or designee. This inspection may be a general work site inspection or may focus on specific areas that may be given significant attention.

Deficiencies will be discussed during the tailgate safety meeting (TSM) so as to prevent reoccurrence of the problem. Deficiencies will be noted by the inspector and abated as soon as possible. A follow up inspection will be made to confirm and document correction of the problem. The Field Manager and EHSO will resolve conflicts that arise concerning H&S.

4.4.4 EHSO's Safety Inspection

Safety inspections are one of the principal ways of locating potential accident causes, and also help in determining what safeguards will be necessary to protect against hazards before an accident or personal injury occurs. These inspections will not be limited to the search for unsafe physical conditions, but will also include methods to detect unsafe practices and unnecessary exposure to hazardous environments. Finding unsafe conditions and work practices by means of these inspections, and correcting them is one of the main objectives of this inspection.

4.5 RECORDS AND REPORTING REQUIREMENTS

IT will notify the RMA's Health and Safety Department, the COE Project Manager, IT's Project Manager, and the Field Manager, of a fatality or serious accident. Fatal accidents will be investigated by the state, federal, or local office having health and safety jurisdiction.

IT will be responsible for the recording and reporting of reportable illnesses and injuries in accordance with OSHA requirements. Copies of these reports will be forwarded to the appropriate personnel. Recordable occupational accidents and illnesses are those defined by OSHA.

A central file of all enforcement inspections and reports along with violations and abatement actions that will be available for inspection by COE personnel will be kept in addition to a central file of formal employee health and safety complaints and reports of their disposition. Upon request, these will be made available for inspection by affected employees or their authorized representative.

Documentation of all employee training, including the OSHA required 40 hour training, site specific training, new employee orientation, refresher courses, respirator fit test results, and respirator training in addition to other requirements specified by OSHA will be maintained in the IT Denver office.

4.6 COMPLAINTS

Employees are encouraged to report to the EHSO any conditions or practices which they consider detrimental to their health or safety or which they believe are in violation of applicable health and safety standards. Such complaints may be made orally or in writing.

Employees who believe that an imminent danger may exist that could threaten human or environmental health, or cause death or serious physical harm, are encouraged to bring this matter to the immediate attention of the EHSO for resolution. In the event of an inadequate corrective action, the employee and/or authorized representative may also contact the local agency having jurisdiction, the IT Project Office, or the COE Health and Safety Official by telephone and set forth with reasonable particularity the basis for their request for an immediate inspection. Competent medical personnel, which may include a physician, will evaluate the symptoms of illnesses that could seriously affect a worker's health and safety.

4.7 INTERNAL AUDITS

The EHSO may conduct internal H&S audits to ensure compliance with the requirements of this plan. An audit will be conducted and will provide follow-up actions if any violation of H&S standards are observed.

4.8 CONTROLLED AREAS

Controlled areas, as defined in Section 8 of this plan, will be established to protect the workers from unnecessary exposure to hazardous and toxic materials and to prevent the spread of contamination. Controlled areas include, but are not limited to, any work areas where the potential exists for significant dispersal of contaminated material from a work area through personnel or equipment transfer.

Access to these controlled areas will be controlled for people, vehicles, and equipment by flagging the area or by using other methods to prevent inadvertent exposure to contaminated material and to maintain a suitable buffer zone. Access to these areas will be limited to authorized persons.

4.9 POSTING

Controlled areas must be conspicuously marked at points of potential access with an appropriate sign(s) according to applicable posting and labeling requirements.

A daily roster containing the date, the person's name who is going on site, the person's signature, the time of entry and the time of exit shall be kept for all persons working in controlled areas. Any visitors to the area must present proper identification and have the appropriate authorization to be on site.

IT's nonessential personnel and visitors to the site will be required to comply with all health and safety restrictions provided in this document. All visitors will be accompanied by an IT site worker at all times and must sign into the access log to gain access to the site.

4.10 OCCUPATIONAL NOISE

Requirements set forth in the OSHA Hearing Conservation Amendment (OSHA 1910.95) will be adhered to during work on site. Both area noise monitoring and personnel noise dosimetry may be conducted by the EHSO when necessary to determine the level of noise and the adequate level of protection. Hearing conservation is of concern due to the use of drilling equipment as well as noisy portable equipment. Hearing protection will be provided where sound

pressure levels exceed 85 dB (a weighted scale, slow response). The rule of thumb is that if you have to shout to be heard, ear protection is needed. Noise suppression devices will be used where appropriate and the use of hearing protection will be mandatory where sound pressure levels in areas and/or on equipment exceed 85 dB (a weighted scale, slow response). IT PRO 9650 (Procedures Appendix; Appendix C) will be followed for hearing protection.

4.11 ACCIDENT PREVENTION PLAN

The primary on-site activity for this project involves soil boring and sample collection within a given area at RMA. Since chemical hazards are discussed in other sections of this report, the Accident Prevention Plan keys into physical hazards of the program.

Accident prevention is a key portion of the safety plan for work at RMA. RMA has a well-developed internal accident prevention program that will be followed by all IT and subcontractor personnel.

A copy of RMA's Master Accident Prevention Safety Program (RMA, May 1983) will be available on site at all times. Appendix D is the COE's Suggested Contractor's Accident Prevention Plan format. All personnel working at RMA will be familiar with this document.

5.0 EMPLOYEE TRAINING

5.1 OSHA REQUIRED TRAINING

All employees who are subject to exposure to on-site contaminants shall have completed the required training under 29 CFR 1910.120. At a minimum, this shall include:

- 40 hours of classroom instruction including specific information required by OSHA;
- Site-specific H&S training;
- 24 hours of supervised field work;
- All supervisors will have had an additional eight hours training on the management of hazardous materials operations;
- At least one person on site will have a current certification in Red Cross First Aid and Cardiopulmonary Resuscitation (CPR) or the equivalent.

Prior to working on site, all subcontractors are required to provide IT with documentation of compliance with 29 CFR 1910.120; specifically training and medical records.

The following is a general list of the topics covered by IT during their training class to achieve compliance with the OSHA standard:

- General site safety (slips, trips, falls, noise, heat/cold stress);
- Information of employee rights (Right-to-Know);
- The specific nature of the operation and field activities which could result in exposure to contaminants above the action level;
- The purpose, proper selection, fit testing, use, limitations of respirators and other safety equipment/personnel protective clothing applicable to the site;
- Information concerning the adverse health effects associated with excessive exposure to on-site contaminants including potential effects of contaminants to skin, eyes, kidneys, liver, etc.;
- A description of the medical surveillance program;
- Medical surveillance requirements including recognition of symptoms and signs that may indicate over exposure to hazards;

- Pathways of exposure including skin penetration/irritation, inhalation, and ingestion;
- Names of personnel and alternates responsible for site H&S;
- Hazards present at the site and the applicable H&S precautions;
- Emergency actions and review of the site-specific contingency plan;
- Work practices by which the employee can minimize risks from hazards;
- Hazard identification and recognition;
- The engineering control and safe work practices associated with the employee's job assignment;
- Methods and procedures utilized for decontamination of personnel and equipment;
- Safe use of equipment on site;
- Prohibitions in the exclusion zone;
- Decontamination procedures.

5.2 SITE-SPECIFIC TRAINING AND INSPECTIONS

As previously stated, a formal site-specific training program to be held on July 5, 1988 will be provided by the EHSO or designee to all site workers before they begin on-site work. The training will be commensurate with the work hazard, and will include discussions of the site-specific RMA remedial investigation project, industrial safety procedures, emergency and contingency procedures, the signs and symptoms of illness, the potential for encountering hazardous materials on the site and the emergency telephone numbers, first aid, and location of the first aid stations and hospitals. The training will also include the highlights of this SHERP, any existing site emergency plan, a detailed description of decontamination procedures, and respirator use.

Practical demonstrations shall be given, when appropriate. Adequate information regarding known hazardous materials that may be encountered on site, including chemical constituents will be provided to ensure compliance with the Hazard Communication Standard (29 CFR 1910.1200). Workers will be informed of the physical hazards at the site. Visitors, prior to going on site, will receive training on the specific hazards they may encounter.

Training will be provided to workers on potential health impacts resulting from chemical exposure. Following the initial site survey, an assessment will be made of these impacts and the health and safety requirements needed for individual areas on site.

Prior to beginning work at a new work location or under different working conditions, the EHSO or designee will provide a briefing to workers stating the nature and extent of contamination to be encountered and an explanation of safety equipment to be used.

The EHSO, being thoroughly familiar with all internal and OSHA H&S policies and rules, and the facility itself, will perform facility safety inspections and will report all findings to the Field Manager. Unannounced inspections may be performed by the EHSO and may include inspection of a particular operation or job task. All safety inspection reports will be maintained on file in the EHSO Office in addition to the project file.

The purpose of these inspections are to determine any problems associated with field activities, and identify any factors that may be causing the problems.

An inspection will be performed once a month of all fire protection equipment by the EHSO or designee. This inspection will include a careful survey to determine if new equipment is needed and what equipment needs replacement or recharging.

Inspections of the general physical work area will also be performed and may include any imminent hazards that should receive special consideration.

5.3 VISITOR TRAINING

Visitors to the site will be allowed upon approval of the Project Manager, Field Manager or designee. After a short site-specific H&S indoctrination, they may proceed with an escort around the general site area. All known contaminated areas will be restricted from visitors unless proof of a physical, training, and need to enter can be shown. Visitors will sign the daily entrance log and site training will be documented.

5.4 TAILGATE SAFETY MEETINGS (TSM)

Job site TSMs will include all employees to be on site and will be conducted at the beginning of each shift, for each job, or whenever new employees or visitors arrive at the job site. Information covered shall include safety concerns that may be encountered during the day, emergency procedures, contingency plan and information on the toxicity and potential hazards associated with chemical contaminants that may be encountered at the job site. Safety meeting information shall be recorded on a TSM form and posted in the work area. An example of the TSM is found in the Appendix C Procedures Section. These forms are to be submitted to the EHSO weekly for review.

5.5 MATERIALS SAFETY DATA SHEETS (MSDS)

A hazard communication program in compliance with 29 CFR 1920.1200 will be in place for the duration of the project. The purpose of this program is to provide information and training to the workers who either work with or around hazardous materials. This includes such information as types of materials and their hazards.

If any employee has a question about a hazardous substance that is associated with their task, they can request a MSDS for that substance which will describe all of the hazards and physical characteristics of the substance and precautions for safe handling and use.

6.0 HAZARD CONTROL AND MONITORING

6.1 GENERAL PRECAUTIONS

The following general safety requirements will be followed in order to minimize the occurrence and potential adverse effects of unsafe or hazardous conditions at the site:

- Contaminated protective equipment, such as respirators, hoses, boots, etc. will not be removed from the regulated area unless it is properly packaged and labeled.
- Legible and understandable precautionary labels will be affixed prominently to containers of contaminated scrap, waste, debris, and clothing.
- Contaminated materials will be stored in tightly closed containers in well-ventilated areas.
- Removal of contaminated particulate from protective clothing and equipment by blowing, shaking, or any other means which disperses contaminants into the air is prohibited.
- No food or beverages will be present or consumed in the contamination or contamination reduction zone.
- Designated break areas will have a hand wash facility.
- No tobacco products will be present or used, and cosmetics will not be applied except in designated break areas. No matches or lighters will be allowed in the exclusion or contaminated reduction zones.
- Personnel on site will use the "buddy" system. Buddies should prearrange hand signals for communication. Communication or visual contact will be maintained between crew members at all times.
- Prompt remedial action will be taken whenever an inadvertent release of a hazardous material occurs.
- Appropriate action to provide secure footing will be taken at all locations where personnel will be working.
- Change rooms and shower facilities will be available for the use of employees working in the field should it become necessary.
- As appropriate, equipment on site will be bonded and grounded, spark proof, and explosion resistant.
- All personnel will avoid contact with potentially contaminated substances. Walking through puddles or mud, kneeling on the ground, or leaning against drums should be avoided whenever possible.

- Monitoring equipment will not be placed on potentially contaminated surfaces.

- Verbally report any signs of radioactivity, explosivity, unexploded ordinance, or unusual conditions (i.e., dead animals) to supervisory personnel and exit the site.

- No facial hair which interferes with a satisfactory fit of the mask-to-face seal will be allowed on personnel who may be required to wear respiratory protection equipment. When air-supplied respirators are used, workers will have the same facial hair restrictions.

- Contact with contaminated or suspected contaminated surfaces will be avoided by personnel working in contaminated areas.

- In certain cases, medicine and alcohol can potentiate the effects from exposure to toxic chemicals. Personnel taking prescribed drugs will consult with the EHSO prior to working where the potential for absorption, inhalation, or ingestion of toxic substances exists.

- All safety equipment will be routinely cleaned, checked, and maintained according to standard operating procedures to ensure the highest level of performance and to reduce any potential for malfunction in the field.

- The consumption of drugs or alcohol will be prohibited during all working hours.

- During the operation, all employees shall be required to wash their hands and face before eating, drinking, smoking, or applying cosmetics. All personnel shall be required to field wash as a minimum before leaving the job site at the end of their shift. Hands and face shall be washed during breaks.

- Containers shall be moved only with the proper equipment and shall be secured to prevent loss of control during transport.

- Emergency equipment shall be located outside the contamination area in readily accessible locations that are exposed to minimal contamination in the event of an emergency.

- Smoking is not permitted in the exclusion or contamination reduction zone or in any structure or building at any time.

- A portable eyewash station or a reasonable alternative shall be located in the regulated area near work activities on site.

- Field personnel must observe each other for signs of toxic exposure. Indications of adverse effects include, but are not limited to:

  - Changes in complexion and skin discoloration
  - Changes in coordination
  - Changes in demeanor

- Excessive salivation and pupillary response
- Changes in speech pattern.

Field personnel shall be cautioned to inform each other of nonvisual effects of toxic exposure such as:

- Headaches
- Dizziness
- Nausea
- Blurred vision
- Cramps
- Irritation of eyes, skin or respiratory tract.

- Sanitary facilities will be accessible.

- Provision must be made for cleaning gross contamination from boots and suits in the Contamination Reduction Zone.

- Whenever solvents, cleaners, or other chemical substances are used for decontamination, a properly completed MSDS for the chemical substance, prepared in accordance with IT PRO 9552 found in Appendix C, shall be available at the work site.

- Whenever flammable or combustible solvents are used for decontamination, specific procedures for the control of flammable gases and vapors may be necessary. When concentrations of flammable vapors cannot be controlled by ventilation, appropriate methods and procedures will be followed. These would include, but not be limited to, the following:

  - Tests shall be made by a qualified person to ensure that concentrations of flammable vapors in the work area do not exceed 10 percent of the lower explosive limit

  - As appropriate, equipment on site shall be bonded, grounded and intrinsically safe

  - An adequate supply of fire extinguishers with a minimum rating of 10 B:C shall be strategically located throughout the work area.

- The EHSO shall take positive steps to ensure that employees are protected from physical hazards which would include, but not be limited to, the following:

  - Discharge of steam, high pressure air, water, or oil
  - Tools or other objects dropping from overhead
  - Falls from scaffolds, stairs, or ladders
  - Tripping over hoses, pipes, tools, or equipment
  - Slipping on wet, oily surfaces
  - Insufficient or faulty personal protective equipment
  - Insufficient or faulty equipment and tools
  - Noise in excess of acceptable levels.

Overall, this SHERP prescribes the work place practices and controls required to prevent employee exposure to site contaminants during handling, processing, or disposal operations. For environmental considerations, reference should be made to applicable EPA and OSHA regulations, state rules, and regulations, and to pertinent IT procedures.

Other data obtained during the project will be used to update this evaluation. A central file of MSDS or other information will be available for site contaminants. If additional contaminants, other than those previously identified, are encountered on site, all personnel will be made fully aware of their hazardous properties and the appropriate procedures which will be utilized to prevent exposure. These procedures will be documented and records maintained by the EHSO.

Some of the chemical contaminants may cause respiratory hazards. During field activities, respiratory protection may be required as a precautionary measure if action levels are detected. Respiratory protection will be discussed later. Also, contaminated particulate distribution may occur when certain site activities disturb the soil surface. Different atmospheric conditions (pressure, humidity, wind, temperature, precipitation) can also have an effect on the concentrations of the contaminants emitted.

The following potential pathways for the contaminant to enter the body should be avoided:

- Ingestion of contaminated ground water;
- Dermal contact with contaminated ground water;
- Ingestion of contaminated sediments and surface soils (accidental or poor hygiene);
- Dermal contact with contaminated sediments and surface soils;
- Inhalation and ingestion of contaminated particles and vapors;
- Dermal contact with contaminated equipment and structures.

Skin and eye contact with contaminants should also be avoided by all site personnel.

6.2 HEAVY EQUIPMENT OPERATION

The following information warrants extra attention regarding work around heavy equipment (drill rigs, front end/backhoe loaders, etc.) and heavy materials:

- Use common sense.
- Hard hats, steel-toed boots, and other protective gear specified in the SHERP are to be worn at all times on site.
- Pay attention at all times.
- Maintain visual contact at all times.
- Establish hand signal communication when verbal communication is difficult. Determine one person per work group to give hand signals to equipment operators.
- All heavy equipment shall have backup alarms of some type, or some other type of warning system must be developed (i.e., blowing horn).
- Only qualified persons are to operate heavy equipment.
- Never walk directly in back of or to the side of heavy equipment without the operator's knowledge.
- Never use a piece of equipment unless you are familiar with the operation. This applies to heavy as well as light equipment (i.e., chain saws).
- Hearing protection will be provided if work site levels exceed the levels specified by OSHA, or if requested by an employee. The rule of thumb is that if you have to shout to be heard, protection should be used.
- Be sure that underground or overhead power lines, sewer lines, gas lines or telephone lines have been identified and will not present a hazard in the work area.
- Ensure that air bottles are secured properly to heavy mobile equipment.
- Mechanical equipment will be inspected daily.

6.3 HEAVY MATERIALS HANDLING SAFETY

The following are guidelines to follow when working with heavy materials handling:

- Be aware of footing at all times.
- Use chains, hoists, straps, and any other equipment to safely aid in the moving or lifting of heavy equipment.
- Use proper lifting techniques. Use your legs, not your back.
- Get help whenever in doubt about a material's weight. Use the buddy system.

6.4 SAFETY PRECAUTIONS WHEN DRILLING

All drillers will wear safety glasses, hard hats, and steel-toed boots and respiratory protection (if required) in accordance with the SHERP. Because tools and heavy equipment can create major hazards at sites, the following procedures are to be followed during soil-boring activities:

- Hard hats are required when working near the drilling rig.
- Goggles or safety glasses will be worn when operating power tools, sanding, grinding, or filing. Welders' glasses or mask will be worn near welding operations.
- No loose-fitting clothing, jewelry, or free long hair is permitted near the rig.
- Hands must be kept away from the moving parts of the machinery when drilling is in progress.
- Daily inspection of all ropes, cables, bolts, and moving parts of the rig is mandatory.
- A first-aid kit and fire extinguisher will be available at all times.
- Self-contained breathing apparatus units will be identified, so they can be obtained, if needed, for emergency use at well or boring sites. The Field Manager will locate this equipment prior to drilling.
- All crews will have at least two persons, and a safety-trained person (Field Manager) will be stationed on site to monitor activities.
- No drilling will occur during impending electrical storms or when rain or icing conditions create a work hazard.
- Keep drill rig clear of any overhead power lines.

6.5 STORAGE OF TOOLS AND EQUIPMENT

IT will provide facilities which will be used to store tools and equipment in order to maintain the site in a clean and orderly manner as indicated by good

housekeeping standards. Contaminated tools will be kept in segregated storage areas from the clean equipment. No materials, tools, or equipment will be stored in such a manner as to interfere with the flow of traffic and field activities, or that could possibly expose buildings, pipe lines, or process equipment to damage in the event of fire.

6.6 HOUSEKEEPING

Housekeeping is a very important aspect of an investigation program and will be strongly stressed in all aspects of field work. Good housekeeping plays a key role in occupational health protection and is a way of preventing dispersion of dangerous contaminants. All work areas will be kept as clean as possible at all times and spills will be cleaned up immediately. Ho sekeeping will be the responsibility of all employees.

IT will implement a housekeeping program for the field activities to minimize the spread of contamination beyond the work site. The program will include:

- Daily scheduling to police the area of debris including paper products, cans, and other materials brought on site;
- Daily changing of wash and rinse water for hands, face and equipment;
- Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing (Tyvek).

6.7 LIGHTING

Should night work be required, lighting for work will follow OSHA standard 1910.120. This will require a minimum 5-foot candle for the general work site and other levels as stipulated.

6.8 SANITATION

An adequate supply of potable water and disposable cups will be supplied for the job site. Outlets dispensing nonpotable water will be conspicuously posted. Only potable water will be stored in the labeled containers.

Toilet facilities will be provided in accordance with 29 CFR 1926.51. Each washing facility will be provided with water, soap, and towels and maintained in a sanitary conditions. Shower facilities will also be provided, if needed.

Designated eating and break areas will be located outside of the controlled area. No contaminated clothing or equipment shall be permitted in these areas.

6.9 FACILITY-SPECIFIC RISKS

Specific health and safety risks associated with the field activities include:

- Equipment malfunctions or accidents.
- Releases of significant volumes of toxic and hazardous materials or wastes through the borehole and release of vapors.
- Dermal contact and inadvertent ingestion of toxic metals, organics or skin irritants during handling of samples, borehole cuttings, etc.

6.10 SAFETY PRECAUTIONS NEAR UTILITY LINES

While in use, the minimum distance a crane or drilling rig to a power line will be:

- 15 feet from a 50 KV line
- 20 feet from a 50 KV to 345 KV line
- 34 feet from a 345 to 750 KV line.

In transit, with a boom or a derrick lowered, the closest approach to a power line will be:

- 15 feet to a 50 KV line
- 15 feet to a 50 KV to 345 KV line
- 15 feet to a 345 KV to 750 KV line.

Personnel from the RMA will be consulted if drilling near buried lines is necessary. Utility clearance and approval from RMA personnel is required prior to subsurface drilling.

6.11 BUDDY SYSTEM

For all on site activities, the buddy system will be implemented to insure safety of personnel. Workers will be required to perform all remedial investigation activities with another individual. At no time, unless otherwise specified by the EHSO or the Field Manager, will workers be permitted to enter the work area alone.

6.12 FIRE AND EXPLOSION PREVENTION

Fire and explosion prevention training will be provided to IT's team members handling any reactive materials. Fire extinguishers will be provided and maintained, and the team members will be instructed on their use. Good housekeeping practices and proper storage of flammable and combustible materials is required. All Class I and II flammable liquids (e.g., motor fuels, paint thinners, and solvents) must be dispensed from approved and properly labeled safety containers.

7.0 OCCUPATIONAL MONITORING AND PERSONNEL PROTECTION

7.1 MEDICAL MONITORING PROGRAM

All IT personnel and subcontractors who perform chemical or waste sampling, drilling, or other field work (except nonworking supervisory personnel and visitors who are typically observing work from a distance) will participate in a pre-employment and an annual medical monitoring program and a respirator fit test. The objective of the medical monitoring program is to determine the medical competency of employees who work while wearing respiratory protection and those who work under the heat and physical stress that may be encountered in the work place in compliance with OSHA requirements. Only those employees determined to be physically capable by a physician will be eligible for respirator fit testing and training and/or assigned work involving physical stress.

The exam shall consist of the following:

- Medical and occupational health history questionnaire
- General physical (attention to skin, liver examination)
- Spirometry (FEV/FVC)
- Audiometry in keeping with OSHA noise standard
- Urinalysis (dipstick and microscopic)
- EKG for persons older than 45 years, or where medically indicated
- SMAC 23 (liver function tests)
- Check x-ray (PA only)
- Complete blood count (CBC)
- Complete blood count with differential.

A work-related chemical history will be acquired by the physician and maintained for each employee working in a controlled area. Results of termination bioassays may be obtained from the last employer if available. If not available, a baseline bioassay measurement will be acquired prior to permitting the employee to perform work.

7.2 PERSONNEL AND ENVIRONMENTAL MONITORING

Air monitoring will be performed during certain tasks in the work area and in the workers breathing zone for contaminated particulates, combustible gases, and chemical vapors. Particulate monitoring may be performed using personal sampling pumps and either cellulosic membrane filters or glass fiber filters. Drilling operations will be monitored using a photoionization detector

(P.I.D.). When a significant change resulting in a reading greater than the TLV in airborne chemical vapors is detected using the P.I.D., operations will be suspended and the EHSO will be notified. Since the P.I.D. is not sensitive to several of the suspected contaminants, traditional industrial hygiene monitoring techniques (i.e., Draeger tubes) may be used to assess employee exposure and will serve as an additional basis for modifying levels of protection.

Employee exposure to sound may be monitored using a sound level meter which meets the requirements of the American National Standard Specification for Sound Level Meters, S1.4, Type S2A. Hearing protection devices will be worn whenever employee noise exposures equal or exceed an eight-hour, time-weighted average sound level of 85 dBA or when employees are exposed to impulsive or impact noises (ACGIH Threshold Limit Values and Biological Exposure Indices for 1987-1988). The rule of thumb is that if you have to shout to be heard, hearing protection is needed.

7.3 MONITORING EQUIPMENT

The general procedure to be followed for monitoring and controlling the health and safety of each task on this project will be as follows. The Field Manager will inform the EHSO of work plans well in advance so that prework surveys of the work area can be completed, if necessary, and documented before work begins. After the prework survey, the EHSO and the Field Manager will discuss the findings of the survey and any other possible hazards.

7.3.1 Thermometer

- Hang in the shade
- Record temperature every two hours if ambient temperatures are higher than 70°F.

Data currently collected by the Ebasco/IT team can be used.

7.3.2 Explosimeter/Oxygen Meter

- MSA combustible gas/O_2 meter Model 260 or equivalent
- EHSO or designee is responsible for use and maintenance of this instrument as instructed by the manufacturer.

7.3.3 Photoionization Detector or Flame Ionization Detector

- P.I.D. Model PI-101 or OVA Model 128
- Instrument detects organic/inorganic compounds.

7.3.4 M-8 Detector

- An army-issued instrument for the detection of phosgene and nerve agents.
- Instrument should be serviced by RMA personnel at least weekly.

7.3.5 M-18A Kit

- An Army-issued kit containing various colored tubes and solutions used in combination to detect GB, H, and VX in water
- See instructions for detection limits and operation.

7.3.6 Detector Tubes

- Draeger Pump and Detector Tubes as follows based on specifications previously identified by Clayton. In the following specifications, the number corresponds to the smallest concentration which can be measured with the tube, and the letter denotes the edition of the tube.

  - Acetone 100/b
  - Benzene 0.5/a
  - Carbon Tetrachloride 5/c
  - Chlorogormates 0.2/b
  - Chlorobenzene 5/a
  - Dimethyl sulphide 1/a
  - Methylene chloride 100/a
  - Trichloroethane 50/d
  - Trichloroethylene 10/a
  - Toluene 5/a - 25/a.

7.3.7 Heat Stress

- Reuter-Stokes RSS-213

7.3.8 Personal Sampling Pumps

- DuPont, MSA or the like

7.4 HEAT STRESS CONSIDERATIONS

Guidelines have been developed by NIOSH for monitoring heat stress and other physiological factors and are published in the "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities." These guidelines, developed for workers in protective clothing, are presented below and have been adopted for the RMA Phase I investigation. At the discretion of the EHSO, the ACGIH method may be used if workers are wearing a normal work uniform.

7.4.1 Heat Stress and Other Physiological Factors

Wearing personal protective equipment (PPE) puts a hazardous waste worker at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including environmental conditions, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at hazardous waste sites, regular monitoring and other preventive precautions are vital.

Individuals vary in their susceptibility to heat stress. Factors that may predispose someone to heat stress include:

- Lack of physical fitness
- Lack of acclimation
- Age
- Dehydration
- Obesity
- Alcohol and drug use
- Infection
- Sunburn
- Diarrhea
- Chronic disease.

Reduced work tolerance and the increased risk of excessive heat stress is directly influenced by the amount or type of PPE worn. PPE adds weight and

bulk, severely reducing the body's access to normal heat exchange mechanisms (evaporation and convection), and increases energy expenditures. Therefore, when selecting the PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress.
Once the PPE is selected, the safe duration of work/rest periods should be determined based on the:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness.

7.4.2 Control and Monitoring

Heat stress may be of concern during some field activities depending upon the ambient temperature. If conditions exist where stress may be anticipated, the danger of employees on site developing heat stress may be monitored by using the Wet Bulb Globe Temperature Index (WBGT) technique. This method requires the use of a heat stress monitoring device, such as the Widget Heat Stress Monitor (Reuter Stokes). The WBGT shall be compared to the TLVs outlined in the ACGIH TLVs Manual, and a work-rest regimen established, as necessary, according to the WBGT obtained.

Because heat stress depends on a number of different factors, all workers, even those not wearing PPE, will be evaluated by the EHSO for heat stress monitoring as follows:

- For workers wearing permeable clothing (e.g., standard cotton or synthetic work clothes), follow recommendations for monitoring requirements and suggested work/rest schedules in the current ACGIH Threshold Limit Values for Heat Stress (ACGIH, 1987-1988). If the actual clothing worn differs from the ACGIH standard ensemble in insulation value and/or wind and vapor permeability, change the monitoring requirements and work/rest schedules accordingly (NIOSH, 1981).

- For workers wearing semipermeable or impermeable encapsulating ensembles, the ACGIH standard cannot be used. For these situations, workers should be monitored when the temperature in the work area is above 70 degrees Fahrenheit (21 degrees Celsius).

This monitoring program will be determined by the EHSO or the Field Manager on a task-by-task basis. Work/rest schedules will be established for each task

and documented. Specific measurements may be necessary to determine the adequacy of the work/rest schedules, including:

- Heart rate: Count the radial pulse during a 30-second period as early as possible in the rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, shorten the next work cycle by one-third and keep the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by another one-third;

- Oral temperature: Use a clinical thermometer (three minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking). If the oral temperature exceeds 99.6 degrees Fahrenheit (37.6 degrees Celsius) shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6 degrees Fahrenheit (37.6 degrees Celsius) at the beginning of the next rest period, shorten the following work cycle by another one-third (NIOSH, 1981). Do not permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6 degrees Fahrenheit (38.1 degrees Celsius) (NIOSH, 1981);

- Body water loss, if possible: Measure weight on a scale accurate to ±0.25 lb. at the beginning and end of each work day to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar clothing or, ideally, is nude. The body water loss should not exceed 1.5 percent total body weight loss in a work day (NIOSH, 1981).

Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work (Table 7-1). The length of the work cycle will be governed by the results of the required physiological monitoring.

7.4.3 Prevention

Proper training and preventative measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat stroke or heat exhaustion, that person may be predisposed to additional heat injuries. To avoid heat stress, project management personnel should take the following steps:

- Establishment of a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts for workers or earlier/later work schedules.
- Cooling devices such as vortex tubes or cooling vests can be worn beneath protective garments.
- If heat stress poses a problem, all breaks are to be taken in a shaded rest area.
- Employees shall remove impermeable protective garments during rest periods.
- Employees shall not be assigned other tasks during rest periods.
- All employees shall be informed of the importance of adequate rest, acclimatization, and proper diet in the prevention of heat stress.
- Adjust work schedules:
  - Modify work/rest schedules according to monitoring requirement
  - Mandate work slowdowns as needed
  - Rotate personnel: alternate job function to minimize over-stress or over-exertion at one task
  - Add additional personnel to work teams
  - Perform work during cooler hours of the day if possible or at night if adequate lighting can be provided.
- Provide sheltered (air-conditioned, if possible) or shaded areas to protect personnel during rest periods.
- Maintain workers' body fluids at normal levels by providing adequate liquids to replace lost body fluids. Replacement fluids can be a 0.1 percent salt water solution, commercial mixes such as Gatorade or Quick Kick, or a combination of these and fresh water. This is necessary to ensure that the cardiovascular system functions adequately. Daily fluid intake must approximately equal the amount of water lost in perspiration, i.e., eight fluid ounces (0.23 liters) of water must be ingested for approximately every eight ounces (0.23 kg) of weight lost. The normal thirst mechanism is not sensitive enough

to ensure that enough water will be drunk to replace lost perspiration (Goldman, 1983). When heavy perspiration occurs, encourage the worker to drink more. The following strategies may be useful:

- Maintain water temperature at 50 degrees to 60 degrees Fahrenheit (10 degrees to 15.6 degrees Celsius).

- Provide small disposal cups that hold about 4 ounces (0.1 liter).

- Instruct workers to drink 16 ounces (0.5 liters) of fluid (preferably water or dilute drinks) before beginning work.

- Urge workers to drink a cup or two of liquid every 15 to 20 minutes, or at each monitoring break. A total of 1 to 1.6 gallons (4 to 6 liters) of fluid per day maintains body weight. When drinking fluids in an area where hazardous materials are present, take precautions not to ingest hazardous materials along with the liquids;

- Encourage workers to maintain an optimal level of physical fitness:

  - Where indicated, acclimate workers to site work conditions: temperature, protective clothing, and workload. See Level of Acclimation at the end of this section.

  - Urge workers to maintain normal weight levels.

- Provide cooling devices to aid natural body heat exchange during prolonged work and severe heat exposure. Cooling devices include the use of field showers, fans, or hose-down areas to reduce body temperature and/or to cool off protective clothing.

- Train workers to recognize and treat heat stress. As part of the training, identify the signs and symptoms of heat stress (Table 7-2).

7.4.4 Other Factors

Personal protective equipment decreases worker performance as compared to an unequipped individual. The magnitude of this effect varies considerably, depending on both the individual and the PPE ensemble used. This section highlights the demonstrated physiological responses to PPE, the individual human characteristics that play a factor in these responses, and some of the precautionary and training measures that must be taken to avoid PPE-induced injury.

The physiological factors which may affect worker ability to function using PPE include:

- Physical condition
- Level of acclimation
- Age
- Gender
- Weight.

7.4.5 Physical Condition

Physical fitness is a major factor influencing a person's ability to perform work under heat stress. The more fit someone is, the more work they can safely perform. At a given level of work, a fit person, relative to an unfit person, will have (Goldman, 1970; McArdle, 1981):

- Less physiological strain
- A lower heart rate
- A lower body temperature, which indicates less retained body heat (a rise in internal temperature precipitates heat injury)
- A more efficient perspiration mechanism
- Slightly lower oxygen consumption
- Slightly lower carbon dioxide production.

7.4.6 Level of Acclimation

The degree to which a worker's body has physiologically adjusted or acclimated to working under hot conditions affects his or her ability to do work. Acclimated individuals generally have lower heart rates and body temperatures and perspire sooner and more profusely. This enables them to maintain lower skin and body temperatures at a given level of environmental heat and work load than unacclimated workers. Perspiration composition also becomes more dilute with acclimation, which reduces salt loss (McArdle, 1981).

Acclimation can occur after just a few days of exposure to a hot environment. NIOSH recommends a progressive six-day acclimation period for the unacclimated worker before allowing him/her to do full work on a hot job. Under this regimen, the first day of work on site is begun using only 50 percent of the anticipated workload and exposure time, and 10 percent is added each day through the sixth day. With fit or trained individuals, the acclimation period may be shortened two or three days. Workers can lose acclimation, however, in a matter of days, and work regimens should be adjusted to account for this.

When enclosed in an impermeable suit, fit, acclimated individuals perspire more profusely than unfit or unacclimated individuals and may therefore actually face a greater danger of heat exhaustion due to rapid dehydration. This can be prevented by consuming adequate quantities of water. See the previous section on prevention for additional information.

7.5 AIR MONITORING

Industrial hygiene monitoring will be conducted at the beginning of the job and periodically thereafter to determine the employee's potential exposures to on-site contaminants. The results of the monitoring will be used as on-site documentation to aid in dictating the selection of the personnel protection equipment. Ambient air monitoring of the surrounding area will also be conducted. Employee exposure records will be kept consistent with OSHA requirements.

Real time air monitoring will be performed during all field activities by utilizing a photoionization detector (P.I.D.). Readings greater than the TLV action level will require action as described in Table 2. The identified ppm level is half the current TLV for the compound that has the lowest TLV of any of the expected contaminants.

If organic chemical vapor monitoring, performed prior to specific work assignments, indicates that concentrations could exceed the limits specified by the ACGIH (1987-1988), monitoring by P.I.D. will be performed during field activities. For personnel working in areas suspected of having high airborne concentrations, organic chemical vapors will be monitored in the breathing zone, using a P.I.D., Draeger tubes and/or battery operated personal sampling pumps. The decision to continue monitoring will be based on the results of the breathing zone monitoring. For multiple hazardous chemicals in the breathing zone, the EHSO will consult the ACGIH (1987-1988) guidelines "Threshold Limit Value for Mixtures" to determine airborne chemical exposures.

Other industrial hygiene monitoring techniques may be used at the discretion of the EHSO. These techniques may include personal or area air monitoring for organic vapors as found in the NIOSH manual of Analytical Methods.

Air monitoring data will be entered on air monitoring log forms. The P.I.D. readings will be averaged and recorded on an hourly basis and every time specified levels are exceeded. The photoionization detector shall be calibrated daily and a record of calibration maintained. Monitoring results will be used to verify the adequacy of protective equipment and to determine if change is needed.

Background will be defined by taking readings upwind of the study area and Basin F. These action levels (changes in PPE or on-site procedures) are subject to field revision at EHSO direction.

Because there is no historical evidence of chemical agent (Section 2.1) contamination in Sections 23 and 26 as indicated in the Clayton SHERP, there will be no continuous chemical agent monitoring. However, when P.I.D. detects significant airborne concentrations of organic compounds above background, the M-18A kit will be used to determine if chemical agents are present. Personnel will immediately don respirators and move 30 feet away from the open hole while the EHSO or designee measures with the M-18A kit. If the results are negative, operations will continue. If the results are positive, the EHSO will suspend operations and the field team will proceed to the Contamination Reduction Zone. Additional precautionary procedures include: (1) contacting the RMA fire department; and (2) contacting the RMA Technical Escort Unit (TEU). Details on these procedures can be found in the USATHAMA Surety Materials Plan.

As indicated in the Clayton report, odors from Basin F have been offensive in the past. As a result, field team members will attempt to shift activities to remain upwind of Basin F. If this is not possible, respirators will be worn if an obvious odor is emanating from Basin F.

This SHERP is not intended to address site work when organic monitoring instrument readings are greater than 500 ppm. When this organic vapor level is determined by any monitoring instrument, all personnel will immediately cease work and evacuate. Each day before work begins, all personnel will familiarize themselves with the location of the nearest evacuation exit. If

wind direction places the support zone in a downwind direction and any contaminant level exceeds five ppm for more than five minutes, personnel in the Support Zone will evacuate to an upwind position. Personnel will not return to the site until authorized by the EHSO.

In addition to the continuous real-time monitoring during drilling and sample logging activities, a field team member can be equipped with a personal sampling pump (MSA or equal) with a collection media as specified in Table 3. Sampling will be conducted at the discretion of the EHSO. This sampling will provide data showing eight-hour time weighted average (TWA) exposures to chemical agents. All analysis of samples will be performed at an AIHA-certified laboratory.

7.6 LEVELS OF PROTECTION/PROTECTIVE CLOTHING AND EQUIPMENT

Personal protective equipment refers to the protective clothing and equipment used to protect individuals from chemical and physical hazards which may be encountered at the site. As a minimum, IT requires coveralls or a change of clothing, safety glasses, and safety shoes for work in the field. In addition to the standard clothing, protective clothing and equipment will be provided to team members based on the hazards expected for specific operations and areas. The types of protective equipment used may range from fully encapsulating chemical resistant suits with supplied air respirators for emergency response, to basic work clothes (including personal clothing) such as coveralls and safety shoes for sample collection. The type of protective equipment selected will be based on the type of operation, area in which the sampling takes place, monitoring results, and chemical hazards involved. In any case, the equipment selected will be designed to protect the employee from the hazard involved.

Table 4 outlines the personal protection levels that will be required on site. Protection levels will be upgraded and downgraded as determined by monitoring, which is performed by the EHSO according to the decision protocol (action levels) described above. Boring locations will be considered as individual isolated exclusion zones for the duration of the drilling program. Based on information about the site's potential hazards, the following protection levels have been designated for the applicable work areas or tasks.

Primary exposure hazards may be from airborne particles, contaminated soils, and contaminated ground water, in addition to skin contact with chlorinated organic solvents. Respiratory protection for these airborne contaminants can be achieved through the use of full-face air purifying respirators with high efficiency particulate air (HEPA) cartridges or with supplied air respirators. If concentrations of organic vapors as measured with the P.I.D. significantly above background, additional industrial hygiene monitoring will be performed to identify the contaminant. Full-face air purifying respirators with organic vapor and HEPA cartridges will be used if approved cartridges at the concentrations found are available. When skin contact with organic solvents is likely, protection will be achieved using polyethylene-coated Tyvek and chemical resistant boots and gloves.

If higher levels of protection are deemed necessary, for example, if the concentration of organic vapors in the workers breathing zone exceeds the specified limit as measured with the P.I.D., if the contaminant has not been identified, or if approved cartridges are not available, then positive pressure supplied air respirators will be required. Operations will be suspended if concentrations exceed the specified limit described in Table 2 as measured with a P.I.D. Since some of the suspected contaminants (e.g., chloroform, trichloroethane, etc.) cannot be detected with the P.I.D., the personal protective equipment requirements will be based on traditional industrial hygiene monitoring techniques.

Personal protective equipment will be provided, based on projected needs. Such equipment may include respirators, respirator eyeglass inserts, safety glasses, ear plugs, coveralls, hard hats, rubber boots, and safety shoes. IT employees will be provided with and required to wear appropriate protective equipment. The ACGIH 1987 guidelines should be referenced for the selection of chemical protective clothing. The EHSO will select and require the use of safety equipment, based on site conditions and any changes in work conditions that may occur. The specific protective equipment and level of protection will be specified on work permits, when applicable. Decisions regarding the protective clothing will be made in conjunction with the Industrial Hygienist as appropriate and monitored by the EHSO.

Equipment to protect the body against contact with known or anticipated chemical hazards has been divided into four categories according to the degree of protection afforded. The level of protection selected will be based primarily on:

- Type(s) and measured concentration(s) of the chemical substance(s) in the ambient atmosphere, its toxicity, and hazard;
- Potential for measured exposure to substances in air, splashes of liquids, or other direct contact with material due to work being performed.

The level of protection necessary for each working condition will be determined by the EHSO, based on a knowledge of the proposed field activities in and near the work location and information on the concentration of each chemical substance to be anticipated. Existing surveys or supplemental surveys in the work area will be used to determine the level of protective clothing needed.

7.6.1 Level A

Level A protection will be required when the type(s) and concentration(s) of toxic substances require the highest level of combined protection to the respiratory tract, skin and eyes, or if the material/contaminant is unknown, but anticipated to require the highest level of protection. These conditions would be:

- Atmospheres which are "Immediately Dangerous to Life and Health" (IDLH). IDLH's can be found in the NIOSH/OSHA's "Pocket Guide to Chemical Hazards" and/or other references.
- Known atmospheres or potential situations that would affect the skin or eyes, or could be absorbed into the body through these surfaces.
- Potential situations where vapors may be generated or splashing may occur through site activities.
- Oxygen deficient atmospheres with the above conditions.

PPE for Level A includes:

- Positive Pressure Self Contained Breathing Apparatus (SCBA) (NIOSH/MSHA approved).

- Totally encapsulating suits (boots and gloves attached).
- Gloves:
  - Outer, chemical protective--depending on suit construction, worn over suit gloves. May be replaced with tight fitting, chemical resistant gloves worn inside suit gloves.
  - Inner, tight fitting, chemical resistant gloves.
- Chemical protective boots - chemical protective, steel toe and shank. Depending on suit/boot construction, worn over suit/boot.
- Hard hat.
- Disposal protective suit, gloves and boots (worn under or over encapsulating suit).
- Coveralls (under suit).
- A means of communications.

7.6.2 Level B

Level B protection will be required when the type(s) and concentration(s) of hazardous substances are known and require the highest degree of respiratory protection, but when a lower level of skin and eye protection is required. Level B may also be needed for some unknown conditions or environments as determined by the EHSO. These conditions would be:

- Atmospheres with concentration of known substances greater than the protection factors associated with full-face, air-purifying respirators with appropriate cartridges
- Atmospheres with less than 20 percent oxygen
- Type(s) and concentration(s) of vapors in air do not present a cutaneous or percutaneous hazard to the small unprotected areas of the body
- A determination is made that potential exposure to the body parts not protected by a fully encapsulating suit (primarily neck, ears, etc.) is highly unlikely
- Activities performed preclude splashing of individuals
- Total sustained vapor concentrations range from 1 ppm to 100 ppm above background (if Draeger tubes are not used to determine actual concentration of compounds with low TLV's) and do not contain high levels of toxic substances affecting skin

- Hazards are completely unknown.

PPE for Level B includes:

- Positive Pressure SCBA or supplied air respirator
- Two-piece chemical resistant suit or one-piece green guardian
- Chemical resistant hood
- Coveralls (fire resistant) under splashsuit
- Gloves
  - Outer, chemical protective
  - Inner, tight-fitting, chemical resistant
- Boots
  - Outer (chemical protective heavy rubber throwaways)
  - Inner (chemical protective, steel toe and shank)
- Means of communications
- Hard hat
- Face shield or eye protection (as needed).

7.6.3 Level C

Level C protection will be required when the type(s) and concentration(s) of respirable material are known, or reasonably assumed to be not greater than the protection factors associated with air purifying respirators; and exposure to the few unprotected areas of the body (i.e., neck and back of head) is unlikely to cause harm.

PPE for Level C includes:

- Air purifying respirator with an appropriate approved cartridge; a half or full facepiece is required depending on the facial protection needed against splashing, grinding, etc.
- Coveralls
  - Chemical resistant
  - Two-piece splash suit (as needed)
- Boots/shoes, leather or chemical-resistant, steel toe, disposable (as needed)
- Gloves (as needed)
  - Outer (chemical protective - as needed)
  - Inner (surgical type)
- Means of communications
- Eye protection
- Hard hat.

7.6.4 Level D

Level D protection is primarily a work uniform and is worn in areas where:

- Only boots are likely to become contaminated
- There is no inhalable or dermal toxic substance
- No hazardous air pollutants have been measured.

Work functions must preclude splashes, immersion or potential for unexpected inhalation of any chemicals.

PPE for Level D includes:

- Coveralls
- Gloves (as needed)
- Boots/shoes, leather or chemical-resistant, steel toe boots (outer), chemical-resistant (disposal as needed)
- Safety glasses--splash goggles or eye protection (as needed)
- Hard hat
- Face shield (as needed)
- Escape mask (as needed).

7.7 RESPIRATORY PROGRAM

It is anticipated that air purifying and supplied air respirators may be required during various field activities. If respiratory protection becomes necessary, the use of supplied air or a half-face air purifying respirator with combination organic vapor/acid gas/HEPA cartridge will be required according to the following outline:

- Monitoring of the work area with the P.I.D. or F.I.D. will be performed whenever sampling or drilling.
- Whenever the vapor concentrations at the work area or breathing zone exceed the specified TLV, the following steps shall be taken:
  - In the field, if a reading exceeds the specified TLV, a Draeger tube will be used if tubes have been manufactured for the particular compound.
  - Evaluate area for temporary interference from sources such as machine exhaust, automobiles, etc.

- If no interference source is present, take a breathing zone reading. If the concentration is less than the specified TLV limit, resume activities.

- If a temporary interference source is detected, wait until it has moved away. Record the reading. If the source is stationary and cannot be removed, note this in the field log and proceed to take breathing zone levels.

- If breathing zone concentrations exceed the specified limit in the breathing zone, evaluate for interference sources. If none are present, continue monitoring breathing zone for five minutes from upwind direction. If levels persist at greater than the specified level, don respirators and continue monitoring. If breathing zone levels are less than the specified level, continue monitoring the drill hole.

- If concentrations are greater than the specified limit in the breathing zone, or if odors, eye irritation, etc. persist after donning air purifying respirators, notify the EHSO or Field Manager who will give specific direction on testing for further evaluation.

• If respirators must be worn, the following steps must be taken:

  - Move downwind and monitor until the concentration is less than the specified limit, or until the perimeter area has been reached.

  - When concentrations are below the specified level, record location in field log.

  - If the specified levels are detected at the perimeter areas, cease field activities.

  - Once downwind limit of the specified levels have been established, all personnel in this area must wear air purifying respirators. Personnel who do not need to be in this area must remain upwind of field activities.

  - Remonitor breathing zone and work site. When two consecutive breathing zone samples at least five minutes apart are below the specified level, respirators may be removed.

• If field operations must be ceased, the Field Manager must:
  - Notify Project Manager
  - Notify EHSO
  - Personnel must move upwind of source
  - EHSO will notify RMA H&S personnel.

• Only properly cleaned, maintained, NIOSH/MSHA approved respirators (half-face, full-face including air supplied, or self-contained breathing apparatus) shall be used on site.

• Selection of respirators, as well as any decisions regarding upgrading of respiratory protection will be made by the EHSO.

- Air purifying cartridges shall be replaced at the end of each shift or when load-up or break-through occur.

- Only employees who have had pre-issue qualitative fit tests and semi-annual fit tests thereafter shall be allowed to work in atmospheres where respirators are required.

- If an employee has demonstrated difficulty in breathing during the fitting test or during use, the employee will have a physical examination to determine whether a respirator can be worn while performing the required duty.

- Where practical, respirators will be assigned to individuals for their exclusive use. The employee will be responsible for the cleaning and maintenance of this equipment.

- Respiratory devices will be cleaned, sanitized, and evaluated for use at the completion of each shift.

- No employee will be assigned to tasks requiring the use of respirators if, based upon the most recent examination, a physician determines that the employee will be unable to function normally wearing a respirator or that the health or safety of the employee or other employees will be impaired by use of a respirator. This will be stated on the medical report.

- Air purifying cartridge respirators will not be used under the following circumstances:

  - Oxygen deficiency

  - IDLH concentrations of specific substances

  - Entry into an unventilated or confined area where the exposure conditions have not been characterized

  - Presence or potential presence of unidentified contaminants

  - Contaminant concentrations are unknown or exceed designated maximum use concentration(s)

  - Identified gases or vapors have inadequate warning properties and the sorbent service life is not known and the unit has no end-of-service-life indicator (ESLI)

  - High relative humidity (may reduce the protection offered by the sorbent).

- Contact lenses are not to be worn at a hazardous waste site, especially while using any type of respiratory protection.

- Air supplied respirators shall be assembled according to manufacturer's specifications regarding hose length, couplings, valves, regulators, manifolds, etc. Air line respirators may need to be used on site.

- Excessive facial hair (beards) prohibits proper face fit and effectiveness of respirators. Persons required to wear full-face or half-face respirators must not have interfering facial hair. All personnel wearing full-face or half-face respirators will be required to be clean shaven prior to each day's shift.

- Regular eyeglasses cannot be worn with full face respirators (breaks the facepiece seal). Inserts must be used.

- The respiratory protection utilized on site will be in compliance with OSHA, 29 CFR 1910.134.

- Where respirators are designated for protection against contaminants, the employee shall be permitted to change canisters or cartridges whenever an increase in breathing resistance is detected.

- Self-contained breathing apparatus (SCBA) will be utilized for emergency procedures and as back-up to confined space entry work.

Respiratory protection will be worn in areas suspected of having contamination until field monitoring is completed. If levels of contaminants as previously discussed are below ACGIH TLVs, and OSHA PELs, at the direction of the EHSO, respiratory protection may be discontinued. Air monitoring will be repeated on a routine basis or whenever there is a significant change in operating parameters. Industrial hygiene monitoring will be performed on employees to measure exposures to dust or other hazardous materials. This information will be used to determine upgrades or reductions in levels of protection including respiratory protective equipment.

The use of full-face respirators provides greater protection factors if a "hot spot" of contamination is encountered and eliminates the need for additional eye protection (e.g., goggles/face shields) which is often considered cumbersome when used with half-face air purifying respirators (APRs). Nose cups along with anti-fog cloths will reduce fogging. If airborne concentrations in an employee breathing zone exceed the previously discussed limits from ambient on-site contamination, a thorough industrial hygiene sampling program may be done to determine constituents. If the location is essential for operation, a self-contained breathing apparatus or air line system will be used.

8.0 SITE ZONING AND ACCESS

Work zones will be established so that: 1) personnel are protected properly against the hazards where they are working; 2) work activities and contamination are confined to the appropriate areas; and, 3) personnel can be located and evacuated in an emergency.

Expected contamination zones will change according to the nature of site operations, (i.e., each boring location will become a contaminated zone for the work duration at that location).

8.1 CONTAMINATION (EXCLUSION) ZONE

The Exclusion Zone is the area where contamination does or could occur. This zone will be field-defined depending on the work site for each particular day. All personnel entering the Exclusion Zone will wear prescribed levels of personal protective equipment. An entry check point will be established at the periphery of the Exclusion Zone to regulate the movement of personnel and equipment into and out of the zone, and to ensure that entry and exit procedures are followed. Any indication by instrument of contamination outside the zone will extend the Exclusion Zone to include newly identified areas. Hourly atmospheric monitoring will occur while personnel are in the exclusion zone.

This zone includes the immediate area of the backhoe, drilling and sampling or other investigative work. This zone has the highest inhalation exposure potential and/or presents a high potential of skin contact with chemicals.

8.2 CONTAMINATION REDUCTION ZONE

This zone comprises the decontamination area, and includes the area surrounding the contamination zone. This zone has the next highest inhalation hazard, but does not have a high probability of skin contact with chemicals. Protective clothing shall be removed and appropriately disposed of before leaving this area. Emergency equipment will be located in this area.

The zone provides a transition between contaminated and clean zones; it serves as a buffer to further reduce the possibility of contaminating or otherwise affecting the clean or support zone. Further, the zone provides additional

assurance that physically transferring contaminating substances on people, equipment, or in the air is limited by combining decontamination, distance between exclusion and support zones, air dilution, zone restrictions and work functions.

8.3 SUPPORT (CLEAN) ZONE

Designated a clean area, this zone is outside the contamination zone. This zone, defined by warning signs will serve as the site entry and exit area, a storage area for clean and decontaminated equipment, and a site services and control area. Adverse exposure to chemicals in this area is unlikely.

8.4 ACCESS

Access to contaminated work areas (contaminated and contamination reduction zones) shall be regulated and limited to authorized persons. A daily roster containing the date, the person's name , the person's signature, the time of entry, and the time of exit shall be kept of all persons working in such areas. Any visitors to the area must present proper identification and be authorized to be on site. Visitors must comply with all aspects of the health and safety plan.

8.5 POSTING/BARRICADES

Warning sings shall be posted and hung, if applicable, in readily visible locations in or near contaminated work areas. Barricades and barricade tape shall be utilized to prevent access to various work areas.

8.6 SITE ENTRY PROCEDURES

The Field Manager will enter the site before any work begins and will verify that the established zones are identified and the escape routes are clearly marked. The initial survey will help determine the boundaries of the respective zones.

The daily site entry procedure (for the EHSO or designee) will be as follows:

- Determine wind direction.
- Confirm proper placement of emergency information and operational status of decontamination facilities.

- Monitor the air for conditions that may cause injury (combustible or explosive atmospheres, oxygen deficiency, potentially toxic substances).
- Visually observe for signs of actual or potential life- or health-threatening hazards.
- Note physical conditions around the site. Determine potential exposure pathways.
- Note any safety hazards (obstacles, terrain stability, etc.).
- Use survey tape or other markers to identify new boundaries of the Exclusion Zone and Contamination Reduction Zone.
- If the danger of heat stress is present, IT will set up a shaded rest area.
- Perform tasks in the site safety plan that meet contract requirements.
- Document site activities with logbooks, field data records, graphs, and photographs. Record observations related to field conditions and size.

All personnel will observe the site entry and exit procedures outlined elsewhere in this plan. The EHSO will discuss site safety and health issues covered by this plan with all personnel prior to beginning site activities and as conditions change. A site safety review will be held for all personnel as often as deemed necessary by the EHSO. The Field Manager and EHSO are responsible for implementing this plan.

9.0 DECONTAMINATION

9.1 CONTAMINATION MONITORING

All personnel leaving the RMA controlled areas who potentially have been in contact with contaminated materials will be monitored with an appropriate detection instrument. Personnel contamination will, to the extent possible, be removed prior to the worker leaving the controlled area.

All potentially contaminated tools and equipment to be released from a controlled area for unconditional use will be monitored and decontaminated, if necessary. In all cases, a reasonable effort will be made to reduce contamination levels to ALARA. Decontamination procedures are outlined below.

For vehicles potentially in contact with material having any quantities of contaminated materials, the tires (and cab interior, if potentially contaminated) will be monitored and decontaminated. Appropriate spot checks will be made of other potentially contaminated truck surfaces. Survey documentation will be sufficient to demonstrate compliance after the fact.

Personnel, equipment, clothing, and samples leaving the Exclusion Zone must be transported to the Contamination Reduction Zone and decontaminated properly disposed of and labeled.

The first step to decontamination is establishing Standard Operating Procedures that minimize contact with contaminants. Institute the following practices:

- Stress work practices that minimize contact with hazardous substances (i.e., do not directly touch potentially hazardous substances).
- Protect monitoring equipment by bagging. Make openings in the bags for sample ports and sensors that must contact site materials.
- Wear disposable outer garments and use disposable equipment where appropriate.

An area in the clean zone will be designated as the break area. Employees will wash their face and hands before eating, drinking, or smoking. All contaminated outer clothing will be removed in the decontamination area prior to each break.

9.2 DECONTAMINATION

Personnel working with hazardous substances may become contaminated in a number of ways, including:

- Contacting vapors, gases, mists, or particulates in the air
- Being splashed by materials while sampling or opening containers
- Walking through puddles of liquids or on contaminated soil
- Using contaminated instruments or equipment.

Protective clothing and respirators help prevent the wearer from becoming contaminated or inhaling contaminants. Good work practices help reduce contamination on protective clothing, instruments and equipment.

Even with these safeguards, however, contamination may occur. Harmful materials can be transferred into clean areas, exposing unprotected personnel. When removing contaminated clothing, personnel may contact contaminants on the clothing and/or inhale them. For personnel or equipment, decontamination will involve physically removing contaminants or neutralizing chemicals such that they become innocuous. For the work area, decontamination may involve the stabilization of materials for disposal. IT field personnel will use the decontamination procedures and decontamination facilities available on site. All decontamination and the control and containment of all contaminated solids and liquids activities will be directed by the Field Manager or EHSO.

Once decontamination procedures have been established, all personnel requiring decontamination must be given precise instructions (and practice, if necessary). Contamination will frequently be monitored by the EHSO or designee. Personnel wearing SCBAs must leave their work area with sufficient air to walk through the decontamination area.

9.2.1 Effectiveness of Decontamination

No known method exist to immediately determine how effective decontamination is in removing contaminants. Discolorations, stains, corrosive effects, and substances adhering to objects may indicate contaminants have not been removed. Observable effects, however, only indicate surface contamination and not permeation (absorption) into clothing. Also, many contaminants are not easily observed.

A P.I.D. will be used to determine the effectiveness of surface decontamination of organic compounds. Once background of the instrument has been determined, a survey of the item decontaminated will be performed. Any reading of five ppm above background will indicate an inefficient decontamination and the material will have to be decontaminated again.

9.2.2 Decontamination Solution

Personal protective equipment, sampling tools, and other equipment are usually decontaminated by scrubbing with detergent water, using a soft bristle brush, followed by rinsing with large amounts of water. While this process may not be fully effective in removing some contaminants (or in a few cases, contaminants may react with water), this method is relatively safe compared with using a chemical decontamination solution which requires that the contaminant be identified. In the latter case, a decontamination chemical is then needed that will change the contaminant into a less harmful substance. Especially troublesome are unknown substances or mixtures from a variety of known or unknown substances.

9.2.3 Decontamination Facilities

Decontamination facilities will be provided for all employees and equipment that enter(s) the area designated as the exclusion zone. Employees working in the contamination or contamination reduction zone will be required to change from street clothing to company provided protective clothing before entering the particular zone, and then to remove the protective clothing when leaving the zone. Employees will be responsible for the decontamination of all equipment and tools used, and their own personnel protective clothing. Modifications will be made to the "decon" plan as applicable to the particular phase of the job and the concentration of contaminants in field.

9.3 DECONTAMINATION OF EQUIPMENT AND VEHICLES

When possible, measures should be taken to prevent contamination of sampling and monitoring equipment. Sampling devices become contaminated, but monitoring instruments, unless they are splashed, usually do not. Once contaminated, instruments are difficult to clean without causing damage to them. Any delicate instrument which cannot be decontaminated easily should be protected

while being used. It should be bagged and the bag should be taped and secured around the instrument. Openings can be made in the bag for sample intake.

All vehicles will be decontaminated at an existing decontamination area on site.

Drilling rigs, tools, and other equipment will be decontaminated as follows:

- Drilling rigs will be moved to the decontamination pad from each boring site in a manner that prevents spreading of drilling cuttings or fluids.
- Augers, tools, and other drilling equipment will be decontaminated after each completed boring; equipment will be placed on plastic and moved to the decontamination pad via truck.
- While on the decontamination pad, each piece of equipment will be steam-cleaned. Tri-sodium phosphate detergent may also be used as necessary for additional equipment cleaning.

9.4 PERSONNEL DECONTAMINATION

A decontamination area consisting of two tubs shall be positioned at the entrance of the contamination reduction zone. Decontamination of personnel and PPE (boots, gloves) will consist of a detergent scrub and water rinse. All persons entering the contamination zones will pass through the decontamination area to don PPE. All persons leaving the contamination reduction zones will either pass through the decontamination area or remove protective clothing before leaving the site. A random personnel survey using a P.I.D. will also be performed on persons leaving the controlled areas to verify that an effective decontamination was achieved. In the event of an emergency, the IT/Ebasco decontamination facilities will be used.

If there is a rip or tear in the employee's PPE and if there is skin contact with a potentially contaminated material, the employee will return to the contamination reduction zone immediately, wash the affected area, and report the incident to the Field Manager or EHSO. They will then determine and authorize, if appropriate, the employee to don new protective clothing and return to the work area. The incident will be recorded in the daily log. Used respiratory cartridges will be discarded, and respirators will be cleaned and sanitized as instructed by the manufacturer. Respirator cleaning will

entail, minimally, a mild (nonirritating) detergent wash, rinse, and inspection for signs of wear.

The life expectancy of organic vapor cartridges cannot be determined at this time; however, cartridges on the respirators being used, at a minimum, will be changed daily. The EHSO will evaluate any reported breathing difficulties, and all personnel experiencing a problem will exit the Exclusion Zone immediately and proceed to the Contamination Reduction Zone for removal according to standard decontamination procedures.

Clothing worn on site will be left on site. Boots and other reusable PPE will remain in the designated storage area. Clean clothing and equipment will be stored in a separate area of the trailer.

All discarded contaminated personal clothing and equipment will be stored in 55-gallon drums. Contamination will be determined visually.

9.5 DECONTAMINATION DURING MEDICAL EMERGENCIES

Exposure to chemicals can be divided into two categories: injuries from direct contact, such as acid burns or inhalation of toxic chemicals; and potential injury due to gross contamination on clothing or equipment.

For the contaminant inhaled, treatment can only be given by a qualified physician. If the contaminant is on the skin or in the eyes, immediate measures must be taken to counteract the substance's effect. First aid treatment usually involves flooding the affected area with water for at least 15 minutes; however, for a few chemicals, water may cause more severe problems, and these chemicals will be identified by the EHSO.

When protective clothing is grossly contaminated, contamination may be transferred to treatment personnel or the wearer and cause injuries. Unless severe medical problems have occurred simultaneously with splashes, the PPE should be washed off as rapidly as possible and carefully removed.

Emergency personnel decontamination will take place at the RMA Health Clinic under the direction of Dr. Lewis. The RMA Health Clinic is fully equipped to

respond to chemical agent emergencies with emergency personnel decontamination, the essential first step after chemical contact.

9.6 PROTECTION FOR DECONTAMINATION WORKERS

The level of protection worn by decontamination workers is determined by:

- Expected or visible contamination of workers
- Type of contaminant and associated respiratory and skin hazards
- Total vapor/gas concentrations in the work area
- Particulates and specific inorganic or organic vapors in the work area
- Results of wipe tests
- The presence (or suspected presence) of highly toxic or skin destructive materials.

Ordinarily, the level of protection worn by the decontamination workers is the same as, or one level lower than the protection of the regular workers in the exclusion zone.

The levels of protection that should be worn during decontamination procedures are as follows:

- Level A Use: Level A is not usually required in decontamination activities.
- Level B Use: In situations where site workers may be contaminated with unknowns, highly volatile liquids, or highly toxic materials, decontamination workers should wear Level B protection. Level B protection includes SCBA, hard hat with face shield, chemical resistant gloves, and protective covering. The clothing suggested is chemical resistant overalls, jacket, and rubber apron. The rubber apron protects the SCBA harness assembly and regulator from becoming contaminated.
- Level C Use: Level C includes a full face, canister-type, air purifying respirator, hard hat with face shield (if splash is a problem), chemical resistant boots and gloves, and protective clothing. The body covering recommended is chemical resistant overalls with an apron, or chemical resistant overalls and jacket. A face shield is recommended to protect against splashes because respirators alone may not provide this protection. The respirator should have a canister approved for filtering any specific known contaminants, such as ammonia, organic vapors, acid gasses and particulates.

- Level D Use: Level D is normally not worn during decontamination procedures. Only under the direction of the EHSO will this level of protection be worn during decontamination activities.

9.7 DECONTAMINATION PRIOR TO BREAKS

During the summer or hot weather, all breaks must be taken in a shaded, clean area specifically provided for that purpose. During the winter or cold weather, all breaks must be taken in a warm area specifically provided for that purpose. When employees leave the exclusion area and enter the contamination reduction zone for a break, they will undergo a modified decontamination procedure. Employees will wash their hands and face with soap and water in the contamination reduction zone and at an appropriate break area. Employees are encouraged to drink plenty of fluids during breaks.

10.0 SAMPLING METHODOLOGY

Numerous samples of various types will be collected by IT to characterize the site soil. Protecting the health and safety of all persons for each of the different sampling operations will require special protective measures to be established on site by the EHSO. General guidance and precautions are presented below by the media to be sampled. Specific methodologies to be followed when sampling in the field are discussed in the appropriate work plans.

10.1 SOLIDS/SLUDGES

The following is the sampling plan for RMA field activities.

10.1.1 Subsurface Soils

The subsurface soils sampling plan is designed to determine the nature and extent of contamination of subsurface soils and the geotechnical properties of the soils. This sampling program will also be part of the ground water monitoring program in that samples will be collected during the well drilling operations. Drilling may occur in all three zones. When the sampling in the contamination and the contamination reduction zones, drillers and sampling team members may be exposed to low-level surface contamination. In addition, workers may come in contact with contaminated ground water. Drilling of the borings comprise the greatest potential exposure hazard during the subsurface soils sampling program. Exposure to airborne contaminants as well as skin contact with hazardous materials is possible during drilling operations. Protective clothing and respiratory protective equipment requirements will be determined by the EHSO based on monitoring results and analytical results as they become available. The highest level of protection expected for drilling operations is Level B, although most drilling is expected to occur at Level C or D. The TSM, which will be reviewed by the EHSO, will outline personnel and area monitoring requirements and protective clothing requirements. A complete clothing change or decontamination of protective clothing and contamination monitoring is required when leaving the contamination zone. Sampling may generate respirable silica and particulates if the soil is dry. Respiratory protection may be required.

The potential exists for exposure to chemical hazards in the contamination reduction zone. Monitoring and protective clothing requirements for sampling in this zone will be specified by the EHSO. Exposure to hazardous materials is not a concern in the clean zone.

10.1.2 Water and Sediments

The monitoring well installation and sampling plan is designed to determine aquifer and ground water characteristics. In the contamination and contamination reduction zones, drillers and sampling team members may be exposed to chemical contaminants. Drilling of the monitoring wells comprises the greater potential exposure hazard during the well installation program. Exposure to airborne contaminants as well as skin contact with hazardous materials is possible during drilling and sampling operations. Protective clothing and respiratory protective equipment requirements will be determined by the EHSO based on monitoring results and analytical results as they become available. The highest Level of protection expected for drilling operations is Level B, although most drilling is expected to occur in Level C or D.

The TSM, which will be reviewed by the EHSO, will outline personnel and area monitoring requirements and protective clothing requirements. A complete clothing change, shower and contamination monitoring is required when leaving the field.

Requirements for work in the contamination reduction and clean zone will be specified by the EHSO.

10.2 PERSONAL PROTECTIVE CLOTHING FOR SAMPLING

10.2.1 Subsurface Soil Sampling

Equipment requirements similar to ground water sampling will be required when collecting subsurface soil sampling. Level B is the highest Level expected although sampling will likely occur at Levels C or D.

10.2.2 Ground Water Sampling

Drilling of the monitoring wells comprise the greatest potential hazard during the ground water investigation program. Based on currently available information, Level B protective clothing may be required for certain on site drilling locations.

- Supplied-air respirator (airline, pressure demand)
- Coated Tyvek coveralls, hooded (polyethylene or saranex)
- Gloves (outer), chemical resistant (nitrile or viton)
- Gloves (inner), chemical resistant (latex)
- Boots (outer), chemical resistant (PVC or neoprene)
- Boot covers (outer), disposal (latex)
- Sampling ground water will usually require chemical resistant gloves and coveralls as described above.

11.0 CONTAMINATED MATERIAL HANDLING

The EPA and Department of Transportation (DOT) have regulations governing the storage, transportation and disposal of hazardous wastes. This section describes the requirements for the packaging, storage and shipment of samples in addition to proper handling and transportation of hazardous waste.

11.1 SAMPLES

Samples collected at RMA should be classified as either nonhazardous or hazardous material. Based on information obtained from the COE, samples collected from the geotechnical soil borings are not expected to be contaminated. Samples collected in the monitoring wells below the zone of saturation are expected to be contaminated.

- Determine appropriate procedures for transportation of samples. If there is any doubt, a sample should be considered hazardous and shipped accordingly.
- Protect the health and safety of the transporter and the laboratory personnel receiving the samples.

11.1.1 Sample Containers

Liquid samples should be placed into the proper sample container as specified for the analysis being performed. The sample container must then be placed into the shipping container that has been filled with enough absorbent material to absorb the liquid if the sample container leaks. Shipping containers, including plastic or steel five-gallon buckets or ice chests with a lid which fits securely, will be used for shipping hazardous materials from the RMA to the laboratory

If it is expected that samples will be shipped off site for analyses, the packaging and shipping of the samples will be done to comply with DOT requirements for limited quantities.

11.2 CERCLA WASTE

11.2.1 Waste Containers

Containers used for the storage of hazardous waste must meet the requirements of DOT as specified in 49 CFR 172 and 173. The containers must be labeled as

prescribed in 49 CFR 172.101 and 172.102. In addition, a hazardous waste label must be affixed that meets the requirements.

Prior to transporting or offering for transportation off site, each container of 110 gallons or less of hazardous waste must be marked with the statement and information required in 40 CFR 262.30.

11.2.2 Storage

Storage of hazardous waste will be the responsibility of RMA. All hazardous wastes, once they have been placed in proper storage containers and properly labeled will be transported to the RMA storage facility for storage prior to disposal. This waste material will be added to RMA's existing inventory for disposal and stored in storage areas identified by RMA. These areas should comply with all governing regulations regarding the storage of hazardous waste.

12.0 EMERGENCY RESPONSE PLAN

12.1 PURPOSE

The purpose of this Emergency Response Plan (ERP) is to minimize potential hazards to human health or the environmental in the unlikely event of a fire, chemical release or exposure or any other unplanned release of hazardous waste to the air, soil or water. A copy of the RMA Emergency Response Plan is found in Appendix E.

12.2 EMERGENCY COORDINATOR (EC)

The EHSO or Field Manager will serve as the Emergency Coordinator (EC). If an incident occurs on site requiring implementation of the Plan, the EHSO will be notified immediately. If the EHSO is not on site, the Field Manager will serve as the EC until the EHSO arrives on site. The Field Manager will be familiar with all aspects of the ERP, site activities, locations and characteristics of all contaminants, location of site records and the site layout. The EC will have the sole authority to commit the resources needed to carry out any emergency procedures.

The responsibilities of the EC include:

- Coordinating with the RMA's EC,
- Assuring that all emergency equipment is routinely inspected and functional,
- Assuring that all emergency response agencies are aware of the provisions of the contingency plan,
- Assuring that the personnel are aware of the potential hazards associated with the operation,
- Monitoring the safety performance of all personnel to ensure that the required work practices are employed,
- Advising on the correction of any work practices or conditions that may result in injury to personnel or exposure to hazardous substances,
- Maintaining waste safety data sheets and inventory of all suspected contaminants.

12.3 EMERGENCY RESPONSE PERSONNEL

All personnel assigned to the project will be trained and be part of the "emergency response team." The operation of the team during times of emergency will be the responsibility of the EC.

12.4 NOTIFICATION

When an incident is discovered, it will immediately be reported to the EHSO or Field Manager. Information should include the nature of the incident and the exact location and suspected contaminants.

The following information regarding the incident should be recorded in the field log:

- Equipment involved
- Quantity of material involved
- Location of incident
- Medical injuries
- Fire or explosions involved or potential
- Emergency response attempts.

12.5 EMERGENCY ASSESSMENT

The EC is the only person authorized to contact the client or regulatory agencies. No statements should be made to anyone without the EC's approval. The EC will assess possible hazards to human health or the environment that may result from an exposure, release, or fire. The EC will assess the hazards posed by an incident through the following steps as appropriate:

- Identifying the wastes involved in the incident
- Consulting the appropriate safety data sheets to determine the potential effects of exposure/release and appropriate safety precautions
- Identifying exposure and/or release pathways and the quantities of waste involved.

12.6 EMERGENCY RESPONSE AGENCY ASSISTANCE

After being notified of an incident, the EC will proceed directly to the scene of the incident to identify the character, the source, amount and extent of release or incident in order to assess the possible hazard to human health and the environment. Based on the assessment, the EC will determine what risks are posed to IT's workers and neighboring workers. If the incident cannot be

controlled by IT's personnel without incurring undue risk, the RMA EC will be contacted. Based on RMA's EC's assessment, evacuation may be ordered and emergency response agencies notified. The initial response to any emergency will be to protect human health and safety, and then the environment. Secondary response to an emergency will be identification, containment, treatment, and disposal assessment. In the event of an emergency, the Rocky Mountain Arsenal's Emergency Coordinator and RMA's Security personnel will be notified as appropriate. The PM RMA will be responsible for notifying any other agencies.

12.7 EMERGENCY RESPONSE ACTIVITIES

The following are situations that may occur that would require IT to respond.

12.7.1 Fire and/or Explosion

If fire or explosion appears to be imminent, or has already occurred, all field activities will be stopped immediately.

The EC will assess the severity of the situation, and decide whether the emergency event is or is not readily controllable with existing portable fire extinguishers or on-site equipment and material at hand. Fire fighting will not be done by IT personnel if the risk to these persons appears to be high.

12.7.2 Spills or Material Release

If a hazardous waste spill or material release is noted, the information will be immediately relayed to the EC. The EC will assess the magnitude and potential seriousness of the spill or release by reviewing the situation at hand. If the accident or incident is determined to lie within IT emergency response capabilities, the EC will implement the necessary remedial action.

12.8 IDENTIFICATION OF HAZARDOUS MATERIALS

MSDSs containing current data characterizing wastes suspected to be encountered will be kept on site. In addition, copies of all MSDS are found in Appendix B. These MSDS contain pertinent data on the waste chemicals at the site including:

- Identification of chemical components
- Identification of wastes hazardous characteristics (e.g. toxicity and ignitability)
- Important chemical and physical properties for each chemical or compound expected such as pH, solubility in water, etc.
- Appropriate procedures to counteract human exposure (e.g. thorough washing with soap and water in the event of dermal contact)
- First aid.

12.9 EVACUATION

If on site, and the situation permits, the EC will assess the emergency or hazardous situation occurring or the potential of occurring on site and will decide whether or not to evacuate the site. If the decision to evacuate is made, the EC will notify the client and all personnel within the affected area. All employees will evacuate the affected area when instructed to and meet at a designated rally point for head count. The designated rally point will be determined and discussed during the daily TSM. It will be the EC's or designee's responsibility to account for everyone that was in the affected area.

12.10 STORAGE, TREATMENT, AND CLEANUP OF RELEASED MATERIAL

Immediately after the emergency, the EHSO will make arrangements for treatment, storage or proper disposal of any recovered wastes, contaminated soil, surface water or any other contaminated materials.

12.11 POST-EMERGENCY EQUIPMENT MAINTENANCE

After an emergency event, all emergency equipment used will be decontaminated and cleaned so that it is fit for use; if not, the contaminated equipment will be properly disposed of and replaced. Before field activities are resumed, an inspection of all safety equipment will be performed by the Field Manager.

12.12 HAZARDOUS WASTE RELEASE REPORT

All spills, leaks, fires and explosions requiring implementation of the emergency plan will be noted in the field log and reported to the appropriate officials by the EHSO within 14 calendar days. This report will include at a minimum:

- Date, time and nature of incident
- Name, quantity and disposition of material involved
- Assessment of impact of human health and the environment.

12.13 EMERGENCY EQUIPMENT

Each work area that might experience an incident requiring emergency response will be equipped with a chemical fire extinguisher. Dry chemical type A, B, and C extinguishers that comply with National Fire Code standards will be used.

Protective clothing and equipment will be available on site for personnel to use when responding to an incident.

12.14 DECONTAMINATION FOR MEDICAL EMERGENCIES

Decontamination of injured personnel may aggravate or cause more serious health effects to the person. If prompt life-saving first aid and/or medical treatment if required, decontamination procedures should be omitted. Whenever possible, response personnel knowledgeable of the suspected contaminants present should accompany contaminated victims to the medical facility to advise on matters involving decontamination.

12.15 AMENDMENT OF CONTINGENCY PLAN

Any change in proposed field activities as a result of expansion, change in type or quantity of waste handled or encountered, or other changes which may affect the degree of severity of a possible emergency situation will be reviewed by the EHSO, and if required, amendments will be submitted to the appropriate RMA personnel and all governing agencies for review and approval. Should the plan fail due to unforeseen factors, immediate revisions will be undertaken by IT to amend the plan to forestall any recurrence resulting from the same factors.

12.16 SAFETY EQUIPMENT AND MATERIALS

An industrial first-aid kit, emergency eye wash, blanket, clean water, paper cups, 20-pound ABC fire extinguishers, outdoor thermometer, and wind flag, already located within the post, should be on site at all times. If the temperature is expected to exceed 80°F, additional items should include

Gatorade or diluted fruit juice and extra instant ice packs. The first-aid kit should also contain reference books on first-aid procedures.

12.17 COMMUNICATION

Communication is vital, not only among team members but between the team and RMA personnel. Both the RMA Fire Division and the COE Safety Office will be informed as required of activities in Sections 23 and 26. The office trailer(s) in the support area will be equipped with a mobile telephone.

The EHSO will prepare a list of emergency telephone numbers to be posted on site. The list also will be incorporated into the SHERP as Appendix E.

12.17.1 Emergency Signals

All team members must readily recognize RMA's emergency signals, which are detailed below:

1. The audible signal pertaining to the Rocky Mountain Arsenal Chemical Agent Independent Control (CAIC) Plan is as follows:

   a. EMERGENCY or EXERCISE signal. A steady, 30- to 45-second tone on the emergency siren. This signal may be used to indicate an actual emergency, such as a major fire, an explosion, or toxicant release; or it may be used to indicate that an exercise of the RMA CAIC Plan is being conducted.

2. Two other audible emergency signals which conform to those established by the Federal Emergency Management Agency are used at RMA as follows:

   a. ATTACK WARNING signal. A three- to five-minute wavering tone of emergency sirens. The signal means that an actual attack against the country has been detected and protective action shall be taken. Proceed to shelter in Building 732 immediately and bring protective mask. THIS SIGNAL WILL NOT BE USED FOR ANY OTHER PURPOSE AND WILL HAVE NO OTHER MEANING.

   b. ATTENTION or ALERT signal. A three- to five-minute steady tone of sirens, horns, or other devices. This signal may be used for any peace-time emergency (e.g., tornadoes, floods, etc.) in which the local Commander desires to alert installation personnel to receive essential information through local media, such as public address systems, telephone, or radio.

   (Source: RMA, November 1983)

3. On-Site Signals

   a. Upgrading Signal. Two blasts from the horn. Should an upgrading of protection level become necessary, a two-horn blast will indicate that all personnel must leave the Exclusion Zone immediately. All personnel will proceed to the Contamination Reduction Zone and await further instruction by the EHSO.

   b. Emergency Signal. Five blasts from the horn. This signal indicates fire, an explosion, or an injury in the Exclusion or Support Zones.

12.17.2 Standard Hand Signals

The following standard hand signals will be used:

- Hand gripping throat--Out of air, can't breathe
- Grip partner's wrist or put both hands around waist--Leave area immediately
- Hand on top of head--Need assistance
- Thumbs up--OK, I am all right, I understand
- Thumbs down--No, negative.

12.18 CHEMICAL AGENTS AND ORDNANCE

During investigations, field teams may encounter chemical agents or unexploded ordnance (UXO). Procedures for handling such occurrences are described below.

12.18.1 Detection of Chemical Agents

The EHSO or designee will monitor boring activities with a P.I.D. instrument and, if necessary, an M-8 instrument and M-18 kit. If a chemical agent test is positive, field team members must act quickly. The procedures to be carried out are as follows:

1. Suspend operations--field team members will proceed to the decontamination area.
2. The EHSO will immediately notify the RMA fire department, which will activate emergency response procedures.
3. Field team members will proceed through decontamination and will be checked by emergency personnel and monitored for symptoms of chemical agent exposure.

4. RMA Technical Escort Unit (TEU) will test the area for chemical agents to confirm the EHSO results.

5. If TEU tests are negative, field operations will resume.

6. If TEU tests are positive, TEU will isolate the area, take more samples if necessary, and remove and decontaminated equipment.

12.18.2 Unexploded Ordnance

If UXO are encountered, field team members will follow the procedures for chemical agents. UXO may contain chemical agents or explosive material. Pictures of UXO will be posted on site so field team members will be familiar with the shapes and sizes of UXO. Any suspicious object found by field team members should be referred to TEU.

12.18.3 Chemical Agent Incident Control

The Chemical Agent Incident Control Plan (CAIC) (RMA, November 1983) is an Army contingency plan for use during chemical agent accidents (CA) or incidents (CI). IT's role in this plan is to notify the Chemical Agent Incident Control Officer (CAICO), Fire Chief (Ext. 223 or 251), and/or Site Security (Ext. 211 or 212) during a chemical agents accident or incident (CA or CI).

12.19 INJURIES AND EMERGENCY SERVICES

12.19.1 Personal Injury in the Exclusion Zone

When an injury in the Exclusion Zone is reported, the Field Manager will be notified. All site personnel will assemble at the decontamination line. The injured person will be moved to the clean end of the CRZ and will be decontaminated to the extent possible prior to movement. In the event of a major injury, the EC or designee will arrange for an ambulance and/or medical response with the RMA Fire Division. Supervisory personnel and the injured person will determine if a medical response is necessary. No persons will reenter the Exclusion Zone until the cause of the injury is determined.

12.19.2 Personnel Injury in Support Zone

After an injury in the Support Zone is reported, contacts with appropriate medical personnel will be made. If the cause of the injury does not affect the performance of site personnel, operations may continue and medical-response personnel can initiate the appropriate first-aid and necessary

follow-up. If the injury puts others at risk, the designated emergency signal will be sounded and all site personnel will move to the decontamination area for further instructions. Activities on site will stop until the added risk is removed or minimized.

12.19.3 Emergency Services

1. Emergency Medical Treatment

   a. Trauma or Other Nonchemical Event

      Call the Fire Division at Ext. 223 or 251 and request an ambulance. The ambulance will take the affected personnel to Presbyterian Hospital in Aurora. Fitzsimons Army Medical Center will be used as a secondary source for emergency care.

   b. Chemical Agent Exposure

      Call the CAICO and Fire Division, which then will activate the CAIC Plan. An ambulance will take exposed team members to the RMA Health Clinic, where decontamination will take place. The team member then will be transferred to Presbyterian Hospital for further treatment.

2. Medical Center Directions

   Directions to the medical facility are as follows:

   a. From: Rocky Mountain Arsenal
      To: Aurora Presbyterian Medical Center

      Leave RMA West Gate, turn south onto Quebec Street, or leave South Gate and proceed to I-70 East. Proceed on I-70 to the I-225 exit south. Proceed on I-225 to the Colfax Avenue exit. On east side of exit.

3. RMA Security

   Security can be reached at Ext. 211 or 212.

12.20 FIRE AND EXPLOSION

After an on-site fire or explosion is reported, site personnel will be notified and will assemble at the decontamination area. The RMA Fire Division will be alerted and all personnel moved to a safe location.

12.21 PERSONAL PROTECTIVE EQUIPMENT FAILURE

If any site worker experiences a protective equipment failure that alters the protection factor, that person and his/her buddy will leave the Exclusion Zone immediately. Reentry will not be permitted until the equipment has been repaired or replaced.

12.22 OTHER EQUIPMENT FAILURE

If any other on-site equipment fails to operate properly, the EHSO will be notified to determine whether site operations may be continued. If the failure affects personnel safety, all personnel will leave the Exclusion Zone until the situation is evaluated and appropriate actions taken.

12.23 EMERGENCY ESCAPE ROUTES

Emergency escape routes are designated in case exit via the normal Contamination Reduction Zone is not possible. The EHSO will designate escape routes, which will be posted with other emergency information at the Command Post, and incorporated as part of the tailgate safety meeting.

12.24 EVACUATION PLAN

If on-site air monitoring with monitoring instruments indicates organic vapor levels higher than 500 ppm, the site will be evacuated. Persons working in the Exclusion Zone will decontaminate and retreat with other site personnel to an upwind location with background monitoring instrument readings. The CPS or EHSO also will notify the RMA Safety Office (Ext. 136) of the readings.

NOTIFICATION WITHIN ROCKY MOUNTAIN ARSENAL

Rocky Mountain Arsenal Emergency Assistance Personnel..... 966-2911
(fire, police, ambulance)

Manager 966-7121

Emergency Coordinator 966-7041

H&S Coordinator (Alma Harris)..... 289-0338

Notification of Outside Agencies

Emergency	Organization/Agency		Phone
Injury	Aurora Presbyterian Medical Center		360-3133
	Air Life		360-3400
	Poison Control Center		332-3073
Fire/Explosion	RMA Fire Department		X 223 or 251
	EPA-Region VIII Response		236-5060
	Commercial Clean Up Firms		
Hazardous Material	RMA Fire Department		X 223 or 251
Release or Spill	EPA-Region VIII Response		293-1723
		After Hours	293-1788
	Colorado Dept. of Health		331-4851
		After Hours	377-6326
Spill involving water	National Response Center		800-424-8802
	Colorado Dept. of Health		320-8333 X 4364
		After Hours	370-9395
	RMA Security		X 211 or 212

CHEMICAL ACCIDENT AND INCIDENT CONTROL: MOUNTAIN ARSENAL DISASTER CONTROL PLAN

1. Chemical Accident (CA). A CA is a situation involving an unintentional or uncontrolled release of chemical agent resulting in:

   a. Exposure of personnel to a chemical agent that results in a fatality, a lost workday case (away from work), or physiological symptoms requiring more than standard first-aid procedures;

   b. Chemical agent hazards off post;

   c. Property damage of $10,000 or more;

   d. Chemical agent presence in atmosphere that exceeds minimum allowable agent concentration-time levels for exposure by unprotected personnel in surrounding areas to which nonrelated personnel have access;

   e. A production interruption that will exceed or has exceeded 24 hours, unless voluntarily interrupted pending the outcome of an investigation;

   f. Significantly degraded operational capability; and/or

   g. Probable high interest by the public or new media.

2. Chemical Incident (CI). Any situation involving chemical surety material that results in:

   a. Personnel exposure to a chemical agent that results in a lost workday case (restricted work activity), light duty, or physiological symptoms requiring standard first-aid treatment;

   b. Unintentional release of a chemical agent not defined as a minor leak or an accident;

   c. Property damage of at least $300 that is not reported as an accident; and/or

   d. Loss (other than caused by acceptable laboratory processes), attempted theft or diversion of chemical surety material, actual or attempted penetration of a chemical limited area, or attempted damage to a storage facility.

   (Source: RMA, November 1983)

13.0 COMPILATION AND SUBMITTALS

13.1 DATA COLLECTION

Records of all health-safety and training activities at the site will be maintained, including records of all health hazard surveys, evaluation of potential hazards, training, and control measures taken. Records required by the state and federal governments will be kept current. The records will document potential exposure levels during field activities. Site employees will be continually informed of exposure levels and the degree of safety measures required for protection from the hazards present. The documented exposure monitoring will serve as a record of assessment of the respiratory hazards at the particular operation of the project and will include the following:

- Determination of personnel activity in the working area:
  - Job routines
  - Work locations
  - Time spent in work area
  - Work rates
- Determination of any potential respiratory hazards:
  - Chemical composition
  - Type of air contamination
  - Toxicity at various concentrations (acute versus chronic)
  - Established concentration limits for breathing
- Determination of whether to improve administrative controls.

Records of all sampling, methodology, calculations, results, reports, and recommendations will be kept for a period of at least thirty years after completion of the project.

13.2 SUBMITTALS

Information will be transmitted to the COE Project Manager as requested and kept in the IT's central files. This information shall include:

- Air monitoring forms
- Personnel sampling data
- Perimeter sampling data
- Area sampling data
- Training logs
- Daily inspection logs
- Visitor sign-in sheets
- Employee injury reports

- Vehicle accident reports
- Tailgate safety meeting forms
- Medical certificates.

All information will be conveyed to the client in a timely manner when requested.

14.0 SAFETY, HEALTH AND EMERGENCY RESPONSE PLAN COMPLIANCE/OSHA

The contractor will comply with all governing regulations as outlined in this SHERP. The EHSO will be responsible for assuring site compliance.

An OSHA poster will be placed in a visible area at the work site to comply with federal regulations.

A variety of ambient air monitoring methods will be used. A project-specific air monitoring plan will be developed to detail the individual site requirements. Detection limits shall be consistent with those in the published procedures.

15.0 ACRONYMS

ACGIH - American Conference of Governmental Industrial Hygienist
ALARA - As Low As Reasonably Achievable
ANSI - American National Standards Institute
APR - Air Purifying Respirators
CA - Chemical Agents Accident
CAICO - Chemical Agent Independent Control Officer
CDH - Colorado Department of Health
CERCLA - Comprehensive Environmental Resource Compensation Liability Act
CFR - Code of Federal Registers
CI - Chemical Incident
COE - Corps of Engineers
CPR - Cardiopulmonary Resuscitation
CY - Calendar Year
db - Decibel
DOT - Department of Transportation
EC - Emergency Coordinator
EHSO - Environmental, Health and Safety Officer
EPA - Environmental Protection Agency
ERP - Emergency Response Plan
F.I.D. - Flame Ionization Detector
H&S - Health and Safety
IDLH - Immediately Dangerous to Life and Health
IH - Industrial Hygienist
IT - International Technology Corporation
LEL - Lower Explosion Limit
MPC - Maximum Permissible Concentration
MSDS - Material Safety Data Sheets
NIOSH - National Institute for Occupational Safety and Health
OSHA - Occupational Safety and Health Administration
OVA - Organic Vapor Analyzer
PEL - Permissible Exposure Limit
P.I.D.. - Photoionization Detector
PPE - Personal Protective Equipment
ppm - parts per million
PRO - Procedure
RCRA - Resource Conservation and Recovery Act
RI/FS - Remedial Investigation/Feasibility Study
RMA - Rocky Mountain Arsenal
SCBA - Self-Contained Breathing Apparatus
SHERP - Safety, Health and Emergency Response Plan
SOP - Standard Operating Procedure
STEL - Short Term Exposure Limit
ta - air temperature
TEU - Technical Escort Unit
TLV - Threshold Limit Value
TSM - Tailgate Safety Meetings
UXO - Unexploded Ordinance
WBGT - Wet Bulb Globe Temperature

REFERENCES

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McArdle, W. D., Katch, F. I., and V. L. Katch, 1981, Exercise Physiology: Energy, Nutrition, and Human Performance, Lea and Febiger, Philadelphia, PA.

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NIOSH, 1985, Chemical Control Corporation, Elizabeth, New Jersey, Hazard Evaluation Report, TA-80-77-853.

NIOSH, 1976, A guide to Industrial Respiratory Protection, NIOSH (DHEW) 76-189, Cincinnati, OH.

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NIOSH/OSHA/USCG/EPA, 1985, Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, October 1985.

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Threshold Limit Values for Chemical Substances and Physical Agents in the Workplace Environment and Biological Exposure Indices with Intended Changes for 1985-86, American Conference of Governmental Industrial Hygienists, Cincinnati, OH.

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U.S. Environmental Protection Agency, 1981, Health and Safety Requirement for Employees Engaged in Field Activities, Order 1440.2, July 12, 1981.

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U.S. EPA, Office of Emergency and Remedial Response, Hazardous Response Support Division, 1985, Field Standard Operating Procedures for Site Entry, FSOP #4.

U.S. EPA, 1984, Standard Operating Safety Guides, Office of Emergency and Remedial Response, Hazardous Response Support Division, Edison, NJ, November, 1984.

TABLE 1

CONTAMINANTS DETECTED IN RMA GROUND WATER AND SOIL

CONTAMINANT	TLV (ppm)*	TOXICITY RATING	SKIN ABSORPTION	CARCINOGEN	GROUND WATER CONCENTRATION DETECTED (ppb)	SOIL CONCENTRATION DETECTED (ppm)	AIR DATA
Acetamide	—	High	No	Yes	—	—	DNA[g]
Acetic acid, phenyl methyl ester	—	—	—	—	—	—	DNA[g]
Acetone	750	Moderate	Yes	No	DNA[h]	—	
Acetonitrile	40	High	Yes	No	430[g]	—	DNA[g]
Aldrin	0.25 (mg/m^3)	High	Yes	Yes	1-<7[c,d,i]	BDL[e]	
Arsenic	0.2 mg/m^3 15 minute ceiling	High	Yes	Yes	DNA-<1,300[h,g]	BDL-4.7[e]	
Atrazine	5 (mg/m^3)	High	No	No	DNA[h]	—	
Benzaldehyde	—	Moderate	No	No	—	—	DNA[g]
Benzene	1	High	Yes	Yes	BDL-76[c,d,i]	—	
Benzene methanol-methyl	—	—	—	—	—	—	DNA[g]
Benzonitrile	—	Low	No	No	—	—	0.089 ug/m^3[g]
Bicyclo (2,2,1) Hepta 2,5 Diene	—	—	No	No	DNA[h]	0.9[g]	
Bladex-Cyanazine	—	High	—	—	DNA[h]	—	
Cadmium	0.05 $mg(Cd)/m^3$	High	No	Yes	—	BDL-2[a,e]	
Carbon Tetrachloride	5	High	Yes	Yes	BDL-<5[d,i]	—	
Chlorate	—	—	—	—	DNA[h]	—	
Chlordane	0.5 mg/m^3	Moderate	Yes	Yes	—	—	
Chloride	—	Low	No	No	25,900,000[i]	—	
Chloroacetophenone	0.3 mg/m^3	High	No	No	—	—	DNA[g]
Chloromethane	105 mg/m^3	—	—	—	70[g]	—	
1-Chloro-4 (methylsulfonyl) benzene	—	Moderate	No	No	—	—	12.6 ug/m^3[g]
Chlorobenzene	75	Moderate	No	No	<0.58[i]	BDL[e]	
Chloroform	10	High	No	Yes	BDL-29.9[d,i]	0.3-70[a]	
p-Chlorophenylmethyl-sulfide	—	—	—	—	BDL-120[c,d,i]	BDL[e]	
p-Chlorophenylmethyl-sulfone	—	—	—	—	BDL-680[c,d,i]	BDL[e]	
p-Chlorophenylmethyl-sulfoxide	—	—	—	—	BDL-120[c,d,i]	BDL[e]	
Chromium	0.5 mg/m^3	High	Yes	Yes	—	9-23[e]	
Copper	1 (mg/m^3)	High	No	No	750,000[g]	9-18[e]	
Cyanide	5 mg/m^3	—	—	—	1.5[g]	—	
p,p^1-DDE	—	—	—	Yes	BDL-<0.05[d,i]	—	
p,p^1-DDT	1 mg/m^3	High	Yes	No	<0.07[i]	50[g]	
Dibromochloropropane (DBCP)	1 ppb (OSHA)	High	No	No	BDL-46[c,d,f,i]	BDL[e]	

TABLE 1

CONTAMINANTS DETECTED IN RMA GROUND WATER AND SOIL
(continued)

CONTAMINANT	TLV (ppm)*	TOXICITY RATING	SKIN ABSORPTION	CARCINOGEN	GROUND WATER CONCENTRATION DETECTED (ppb)	SOIL CONCENTRATION DETECTED (ppm)	AIR DATA
Methyl thiocyanate	—	—	—	—	—	—	DNA[g]
Nitromethane	100	High	No	No	—	—	DNA[g]
2-Nitropropane	10	High	No	Yes	—	—	DNA[g]
1,4 Oxathiane	—	Low	No	No	BDL-65[c,d,i]	—	
Phosphate	—	—	—	—	DNA[h]	4[g] (acid, ethylester)	
Sulfate	—	—	—	—	25,000,000[g]	—	
Tetrachloroethylene	50	High	Yes	Yes[e]	<1.3-32[c,i]	BDL[e]	
Toluene	100	High	Yes	No	<10-1,250[c,i]	BDL[e]	
Trichlorobenzonitrile	—	—	—	—	—	—	DNA[g]
1,1,1 Trichloroethane	350	High	Yes	No	DNA[h]	0.4[a]	
1,1,2-Trichloroethane	10	High	Yes	Yes[e]	—	—	
Trichloroethylene	50	High	Yes	Yes	<5.5-7.6[c,i]	—	
Xylenes	100	Moderate	Yes	No	2.55[c,i]	BDL[e]	
Zinc	—	High	No	No	—	BDL-73[e]	

[a]Section 26-6 and site-specific ground water data from: Environmental Science and Engineering, Inc., 1988, "Final Phase I Contamination Assessment Report Site 26-6: Basin F," May 1988.

[b]Tank Site data from: Environmental Science and Engineering, Inc., 1988, Draft Final "Baseline Contamination Assessment Basin F Tank Site," January 1988.

[c]Section 23 data from: Environmental Science and Engineering, Inc., 1987, Draft Final "Phase I Contamination Assessment Report Section 23—Uncontaminated," November 1987.

[d]Section 26 and site-specific ground water data from: Environmental Science and Engineering, Inc., 1987, "Final Phase I Contamination Assessment Report Section 26—Uncontaminated," September 1987.

[e]Site-specific data from Sections 23[c], 26[d], and tank site[b].

[f]Sirrine, 1987, "Literature Research and Review of Groundwater Quality and Treatment Systems for Basin F, Rocky Mountain Arsenal, "Final Engineering Report, June 1987.

[g]Ebasco, 1988, "Safety, Health, and Emergency Plan for the Basin F Interim Remedial Action," April 1988.

[h]Clayton Environmental Consultants, Inc., 1987, "Safety, Health, and Emergency Response Plan for a Geotechnical Drilling Program at the Rocky Mountain Arsenal Sections 23 and 26," September 4, 1987.

[i]Environmental Science and Engineering, Inc., 1986, Draft Final "Initial Screening Program Report," Volume II, October 1986. (Data from Well #26041.)

*Sources: Contaminants - USATHAMA Data Base
T.L.V.—ACGIH 1986—1987 TLV's
I.D.L.H.—NIOSH/OSHA Pocket Guide to Chemical Hazards
Table 1—Clayton SHERP for RMA
Table 5-1 Ebasco SHERP for RMA
Hazardous Chemicals in the Workplace—N. Irving Sax

** - Intended change
A^2 - Suspected human carcinogen
Ca - NIOSH recommends that the substance be treated as a potential human carcinogen
— - Data not available
DNA - Detected, but data not available

TABLE 3

CONTAMINANTS DETECTED IN RMA GROUND WATER
(Clayton Health and Safety Plan)

CONTAMINANT	COLLECTION MEDIA	ANALYSIS	NOISH METHOD
Acetone	Charcoal	GC	1300 (3rd Ed.)
Aldrin	GE filter (15 ml iso octane)	GC	5502 (3rd Ed.)
Arsenic	MCE filter	AA	7900 (3rd Ed.)
Atrazine	GF filter	GC	---
Benzene	Charcoal	GC	1500 (OSHA)
Bicyclo (2,2,1) Hepta 2,5 Diene	GF filter	GC	---
Bladex-Cyanazine	GF filter	GC	---
Carbon Tetrachloride	Carcoal	GC	1003 (3rd Ed.)
Chlorate	GF filter	GC	---
Chloride	Impinger (10 ml acetate buffer)	ISE	115 (1) (2nd Ed.)
Chloroform	Charcoal	GC	1003 (3rd Ed.)
p-Chlorophenylmethyl-sulfide	Charcoal	GC	---
p-Chlorophenylmethyl-sulfone	Charcoal	GC	---
p-Chlorophenylmethyl-sulfoxide	Charcoal	GC	---
Copper	MCE filter	AA	7029 (3rd Ed.)
Dibromochloropropane	Charcoal	GC	OSHA
Dichlorobenzene	Charcoal	GC	1003 (3rd Ed.)
Dichloroethylene	Charcoal	GC	1003 (3rd Ed.)
1,1 Dichloroethane	Charcoal	GC	1003 (3rd Ed.)
Dicyclopentadiene	GF filter/charcoal	GC	---
Dieldrin	GF filter	GC	S283 (3) (2nd Ed.)
Diisopropylmethyl-phosphonate	Charcoal	GC	---
Dimethyl Disulfide	Charcoal	GC	---
1,4 Dithiane	Charcoal	GC	---
Endrin	MCE filter Chromosorb 102	GC/EC	S284 (g) (2nd Ed.)
Fluoride	MCE + Na_2CO_3 treated cellulose filter	ISE	7902 (3rd Ed.)

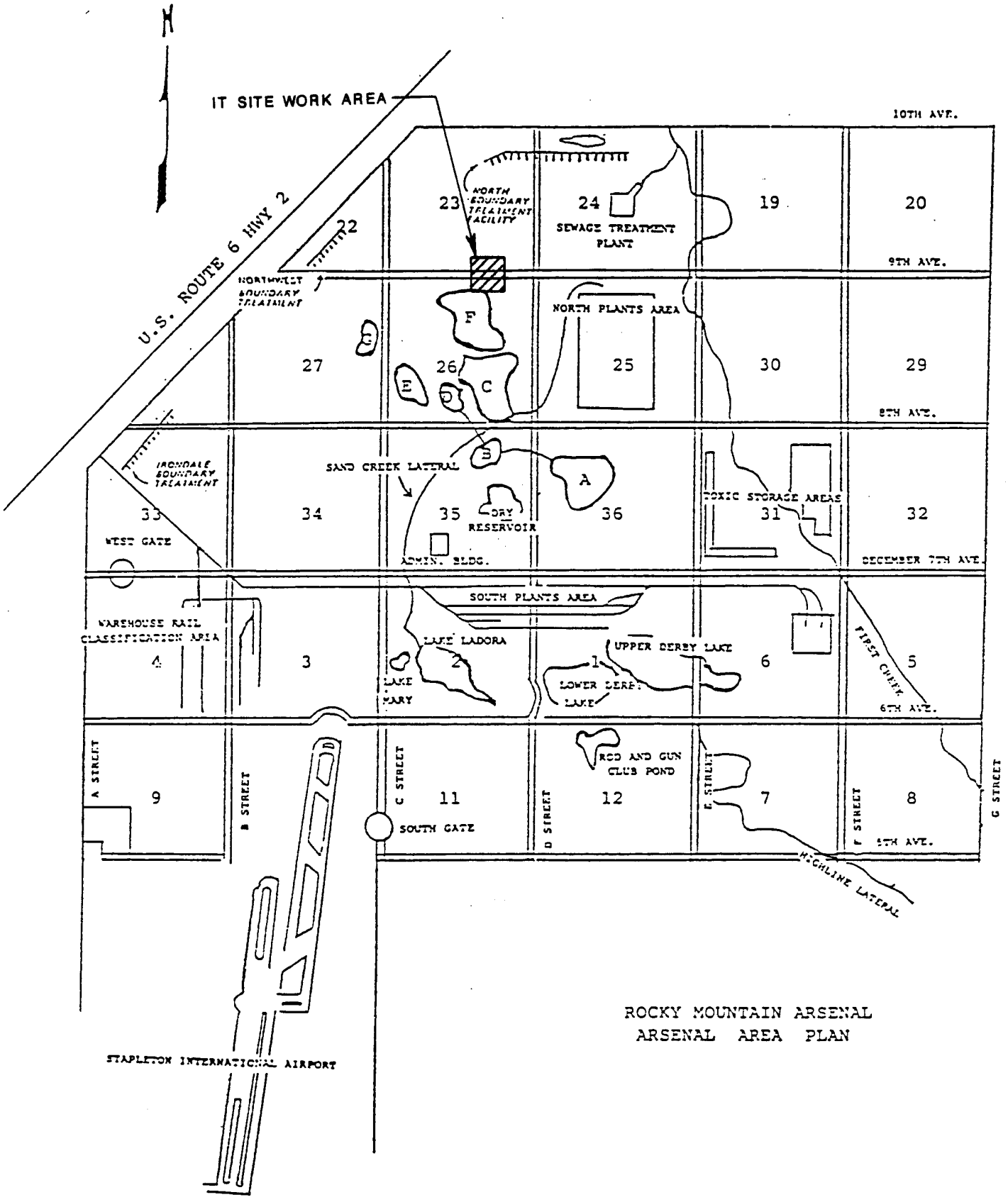
TABLE 4

LEVELS OF PERSONAL PROTECTION REQUIRED ON SITE

LOCATION	JOB FUNCTION	LEVEL OF PROTECTION
Section 23	Drilling/Sampling	C/D
	Sample Logging	C/D
	Surveying	D
Section 26	Drilling/Sampling	C/D
	Sample Logging	C/D
	Surveying	D

Monitoring by the EHSO at each location during soil boring location will determine the extent of the Exclusion Zone.

At a minimum, steel-toed boots, hard hats, and safety glasses are to be worn at all times while on site, regardless of the level of protection specified.



ROCKY MOUNTAIN ARSENAL
ARSENAL AREA PLAN

FIGURE 1

APPENDIX A

HEALTH AND SAFETY PLAN CONSENT FORM
SAFETY, HEALTH AND EMERGENCY RESPONSE PLAN--ROCKY MOUNTAIN ARSENAL

I understand and agree to comply with the provisions set forth in this Health and Safety Plan as explained in the site-specific training conducted July 5, 1988.

Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Name	Signature	Date
Project Manager	Signature	Date
Environmental Health and Safety Officer	Signature	Date
Field Manager	Signature	Date

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

NO. 397
n-HEXANE
Revision B
DATE August 1983

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: n-HEXANE
DESCRIPTION: n-Hexane or a mixed isomer solvent with substantial levels of n-hexane
OTHER DESIGNATIONS: Hexane, $CH_3(CH_2)_4CH_3$, C_6H_{14}, ASTM D1836, CAS# 000 110 543

MANUFACTURER: Available from many sources.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Typical Composition:		
n-Hexane (major component)	>98	8-hr TWA 50 ppm* or 180 mg/m^3
Other Hexanes (minor component or nil)	Trace	
Other Saturated Hydrocarbons (C_5 to C_7)	Trace	
Olefinic Hydrocarbons (C_5 to C_7)	<0.1	Human, Inhalation TCLo 5000 ppm/10M CNS Effects
Aromatic Hydrocarbons		Mouse, Inhalation LCLo 120 gm/m^3

*ACGIH (1983) TLV. Level set to prevent possible nerve cell damage (peripheral neuropathy). Current OSHA 8-hr TWA is 500 ppm.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F --- ca 152-156*	Specific gravity (20/4C) -- ca 0.66*
Vapor pressure at 60 F, mm Hg - ca 100*	Volatiles, % ---------- 100
Vapor density (Air=1) --------- 3	Melting point, deg F ------ -139
Water Solubility ---------- Insoluble	Molecular weight ---------- 86.20

Appearance & Odor: A clear, colorless, mobile fluid. Mild hydrocarbon odor.

*Precise values depend on the grade of the hexane.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
<0 F (TCC)	500 F	Approx. % by volume	1.2	7.5

Extinguishing media: Use carbon dioxide, dry chemical or foam. Water may be ineffective in putting out fire and a water stream will spread flames; but a water spray should be used to cool fire-exposed containers to prevent pressure build-up and rupture.
This flammable liquid is a dangerous fire hazard, and a dangerous explosion hazard when heated. Fight fire from a safe distance. (Hexane burns like gasoline.)
Firefighters should wear self-contained breathing apparatus and proper eye and skin protection.

SECTION V. REACTIVITY DATA

This is a stable liquid in a closed container at room temperature. It does not polymerize.
This highly flammable liquid (OSHA Class 1B) must be kept away from heat, and sources of ignition. It is incompatible with oxidizing agents.
Thermal-oxidative decomposition products in air can include carbon monoxide.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

From Genium's MSDS Collection, to be used as a reference.

MSDS # 354
METHYL ALCOHOL
Revision C

Issued:
Revised: September, 1985

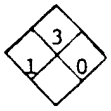
SECTION 1. MATERIAL IDENTIFICATION

17

MATERIAL NAME: METHYL ALCOHOL

OTHER DESIGNATIONS: Methanol, Wood Alcohol, Carbinol, Wood Naphtha, Methyl Hydroxide, Monohydroxy Methane, CH_3OH, CAS #67-56-1

MANUFACTURER/SUPPLIER: Available from several suppliers, including: E.I. DuPont DeNemours & Co. (302- 774-2290
Chemicals & Pigments Dept (800) 441-9442
1007 Market St. Wilmington, DE 19898



SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
METHYL ALCOHOL CH_3-OH	ca 100	8 hr TWA: 200 ppm, or 260 mg/m^3* (Skin) STEL: 250 ppm, or 310 mg/m^3 HUMAN Eye: 5 ppm, primary irritation dose Oral: LDLo: 340 mg/kg Inhalation: TCLo: 86,000 mg/m^3 - Toxic irritant effects (systemic)

* Current OSHA Standard; ACGIH (1985-86) TLV adds (skin) notation.

NIOSH has recommended a TWA standard of 200 ppm with a fifteen minute ceiling of 800 ppm. This ceiling is well above the TLV STEL of 250 ppm.

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm	148.5°F (64.7°C)
Vapor density (Air=1)	1.11
Vapor pressure @ 21°C, mmHg ...	100
@ 50°C, mmHg ...	400
Water Solubility	Totally Miscible
Viscosity @ 20°C, cps	0.59
Specific gravity, 20°/4°C ...	0.791
Melting point	-144°F (-97.8°C)
Volatiles, %	ca 100
Evaporation rate (BuAc=1) ...	5.9
Molecular weight	32.04

APPEARANCE & ODOR: Clear, colorless, highly polar liquid with a characteristic alcohol odor. The odor recognition threshold (100% of test panel) is 53.3 ppm

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
60.8°F (12°C) Closed Cup	725°F (385°C)	% by Volume	6	36.5

EXTINGUISHING MEDIA: Use carbon dioxide, dry chemical, or alcohol type foam. Do not use a solid stream of water since the stream will scatter and spread the fire. Use water spray to cool fire-exposed tanks/containers. Fires involving Methyl Alcohol are Class IB; use a blanketing effect to smother fire.
Methyl Alcohol is a moderate explosion hazard and a dangerous fire hazard when exposed to heat, sparks, flame or oxidizers. Its vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving Methyl Alcohol.

SECTION 5. REACTIVITY DATA

Methyl Alcohol is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization. This material may react violently with chromic anhydride; iodine plus ethyl alcohol, and mercuric oxide; lead perchlorate; perchloric acid plus ethyl alcohol; dimethyl formamide plus phosphorous; potassium hydroxide plus chlorloform; sodium hydroxide plus chloroform. It may also react with metallic aluminum at high temperatures.
Methyl Alcohol is incompatible with strong oxidizing agents (eg., nitrates, perchlorate or sulfuric acid), active metals, acetaldehyde, ethylene oxide, isocyanates, beryllium dihydride, chloroform, and potassium tert-butoxide. It may attack some forms of plastics and rubber. Thermal decomposition or burning will produce carbon monoxide, carbon dioxide and possible toxic formaldehyde and unburned methanol.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP.

No. 71

QUARTZ

Date September 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: QUARTZ
OTHER DESIGNATIONS: Silica, Crystalline; Flint; Agate; Sand; Silicic Anhydride; Silica Flour; Silicon Dioxide; SiO_2; GE Materials D4C15, D4C19, D4C38, D4C39, D4C45-47, and D4C50; CAS #014 808 607
MANUFACTURER: Available from many sources.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Silicon Dioxide, Crystalline (Quartz form) *Current OSHA Standard. ACGIH (1980) 8-hr TWA is 3 mppcf** or 0.1 mg/m^3 for respirable dust. (Values for total dust, mg/m^3, are three times higher for both OSHA and ACGIH.) NIOSH (1974) has proposed a 10-hr TWA of 0.05 mg/m^3, permissible exposure level. **Millions of particles per cubic foot of air.	>98	8-hr TWA (Resp. Dust)* $\frac{250 \text{ mppcf}^{**}}{\%SiO_2+5}$ or $\frac{10 \text{ mg/m}^3}{\%SiO_2+2}$ Human, inhalation TCLo 16 mppcf/8-hr intermittent for 17.9 yr Pulmonary Effects Rat, TDLo 90 mg/kg Intraperitoneal - Neoplastic Effects Intrapleural- Carcinogenic Effects

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C -----	2230	Specific gravity (H_2O=1) -----	2.65
Vapor pressure at 1732 C, mm Hg ---	10	Melting point, deg C ---------	1610
Water solubility ----------	Insoluble	Formula weight (SiO_2) --------	60.09

Appearance: When pure, material is white powder or colorless crystals. Impurities can produce various colorations.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER

This material is noncombustible. Use extinguishing media appropriate to the surrounding fire.

SECTION V. REACTIVITY DATA

Material is highly stable under ordinary conditions (sand-like).
When exposed to high temperatures, quartz (or amorphous silica) can change crystal structure to form tridymite (above 870 C) or cristobalite (above 1470 C) which have greater health hazards than quartz.
It is attacked by strong alkalis. It will combine chemically with many metallic oxides upon heating at high temperature. It reacts with hydrofluoric acid to generate volatile SiF_4. It is incompatible with oxygen difluoride, chlorine trifluoride, manganese trifluoride, and certain other powerful oxidizers and fluorine-containing compounds.

MATERIAL SAFETY DATA SHEET

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1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854

From Genium's MSDS Collection, to be used as a reference.

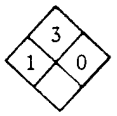
MSDS # 300
ACETONE (Revision D)

Issued:
Revised: September, 1985

SECTION 1. MATERIAL IDENTIFICATION

17

MATERIAL NAME: ACETONE
OTHER DESIGNATIONS: Dimethylformaldehyde, Dimethylketal, Dimethyl Ketone, Ketone Propane, Pyroacetic Acid, Pyroacetic ether, C_3H_6O, CAS #000 067 641
MANUFACTURER/SUPPLIER: Available from many suppliers, including;
Dow Chemical USA
2020 Dow Center
Midland, MI 48640 (517) 636-1000



SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
ACETONE $CH_3 - C(=O) - CH_3$ * Current (1985-86) ACGIH TLV/STEL. The OSHA PEL is 1,000 ppm, 2,400 mg/m^3. NIOSH recommends a 10-hr TWA or 250 ppm or 590 mg/m^3 and defines the "action level" at half this exposure. This recommendation is based largely on complaints of workers with exposures of 1000 ppm or less, together with human subject experiments of Nelson et al.	ca 100	8 hr. TWA: 750 ppm, 1,780 mg/m^3 STEL: 1,000 ppm 2,375 mg/m^3* Rat, oral LD50: 9750 mg/kg Rabbit, skin LD50: 20 g/kg Human, Inhalation: 12,000 ppm/4 hrs.: CNS TCLo: 500 ppm, eye irritation & eye systemic effects.

SECTION 3. PHYSICAL DATA

Boiling point, 1 atm	133°F, (∿56°C)
Vapor pressure, mmHg, @ 20°C ...	180
@ 25°C ...	226
Vapor density (Air=1)	2.0
Water Solubility @ 25°C	Complete
Specific gravity (20/4°C)	0.79
Volatiles, %	ca 100
Melting point	-70.6°F, (-95°C)
Evaporation rate (n-BuAc=1) ...	∿7.7
Molecular weight	58.09

APPEARANCE & ODOR: A clear, colorless, volatile liquid with a characteristic, pleasant sweetish odor. Odor recognition threshold (100% of test panel) is 100-150 ppm (also reported between 200 and 400 ppm); odor is distinct at 680 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
-4°F (-20°C) T.C.C.**	>1000.4°F (>538°C)	% by volume**	2.6	12.8

EXTINGUISHING MEDIA: Carbon dioxide, dry chemical, alcohol foam. Use water spray to cool fire-exposed containers and to dilute and reduce fire intensity. Water may not be effective in extinguishing fires involving acetone.* Acetone is a dangerous fire hazard and moderate explosion hazard when exposed to heat, flame and oxidizers. Vapors are heavier than air and may travel a considerable distance to an ignition source and flashback. Use a blanketing effect to smother flame. Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving acetone.

* 10% solution of acetone in water is reported to have a flash point of ∿80°F.

** Higher closed cup flash points and lower LEL and lower UEL also are reported.

SECTION 5. REACTIVITY DATA

This OSHA Class IB flammable liquid is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization.

Acetone reacts vigorously with strong oxidizing agents, such as nitrates, perchlorates, and concentrated sulfuric acid. It is incompatible with chromic anhydride, chromyl chloride, hexachloromelamine, hydrogen peroxide, nitrosyl chloride, permonosulfuric acid, mixtures of nitric acid and sulfuric acid, and mixtures or nitric acid and acetic acid. It ignites when reacted with potassium tert-butoxide.

Thermal decomposition or burning produces carbon monoxide and carbon dioxide.

MATERIAL SAFETY DATA SHEET

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SCHENECTADY, NY 12303-1836 USA
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GENIUM PUBLISHING CORP.

No. 316

BENZENE

Revision C

Date November 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: BENZENE

OTHER DESIGNATIONS: Benzol, Phenylhydride, Phene, C_6H_6, GE Material D5B53, ASTM D835, D836, D2359, CAS #000 071 432

MANUFACTURER: Available from many sources.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Benzene *Current OSHA and ACGIH (1978) permissible exposure level. Note that the OSHA standard on benzene which would reduce the TLV to 1 ppm with a 5 ppm ceiling, forbid contact with liquid with over 0.5% benzene, and legally classify benzene as a human carcinogen has been struck down by U.S. Court of Appeals. ACGIH (1978) lists benzene as a suspected carcinogen for humans.	ca 100	8-hr TWA 10 ppm (skin)* with 25 ppm ceiling level and 50 ppm 10 minute peak

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C)	176 (80)	Specific gravity, 20/4 C	0.879
Vapor pressure at 20 C, mm Hg	74.6	Volatiles, %	ca 100
Vapor density (Air=1)	2 77	Evaporation rate (CCl_4=1)	1.0
Solubility in water, wt. %	0.06	Molecular weight	78.12
		Melting point, deg F (C)	42 (5.5)

Appearance & Odor: Clear, colorless liquid having a characteristic aromatic odor. The odor recognition threshold (100% of panel) is 4.68 ppm (unfatigued) in air. Odor is is not an adequate warning of hazard.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air Volume %	LOWER	UPPER
12°F (-11C) (TCC)	1044°F (562°C)		1.3	7.1

Extinguishing Media: Water fog, CO_2, dry chemical or foam. Use a blanketing effect to smother fire. A water stream will scatter the fire. A water spray can be used to cool fire exposed containers.

Firefighters should wear approved self-contained breathing apparatus.

This material can form explosive and flammable mixtures with air at room temperature. It is a severe explosion hazard and toxic hazard in a fire situation. Vapors can flow along surfaces to distant ignition sources and flash back.

SECTION V. REACTIVITY DATA

Benzene is a stable compound under normal storage and use conditions; it does not polymerize.

Benzene will react vigorously with strong oxidizers such as ozone, permanganate, sulfuric or nitric acids, potassium peroxide, sodium peroxide, et al. It is a flammable liquid. OSHA Class IB. Heating greatly increases the fire and explosion hazards.

Oxidation in air will produce oxides of carbon and nitrogen.

Occupational Health Guideline for Carbon Tetrachloride*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CCl_4
- Synonyms: Tetrachloromethane
- Appearance and odor: Colorless liquid with an ether-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for carbon tetrachloride is 10 parts of carbon tetrachloride per million parts of air (ppm) averaged over an eight-hour work shift, with an acceptable ceiling concentration of 25 ppm and a maximum allowable peak of 200 ppm for up to 5 minutes in any four-hour period. NIOSH has recommended that the permissible exposure limit be reduced to a ceiling level of 2 ppm averaged over a one-hour period, and that carbon tetrachloride be regulated as an occupational carcinogen. The NIOSH Criteria Document for Carbon Tetrachloride should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Carbon tetrachloride can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Exposure to carbon tetrachloride may cause drowsiness, dizziness, incoordination, and unconsciousness. Delayed effects from short-term overexposure include damage to the heart, liver, and kidneys. Symptoms of liver damage include yellow jaundice and dark urine. Eye contact with liquid carbon tetrachloride causes burning and intense irritation.

2. Long-term Exposure: Prolonged or repeated exposure may cause liver and kidney damage. Repeated or prolonged contact of the liquid with the skin may cause skin irritation.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to carbon tetrachloride.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to carbon tetrachloride at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of liver and kidneys should be stressed. The skin and eyes should be examined for evidence of chronic disorders.

—Liver function tests: Carbon tetrachloride causes liver damage. A profile of liver function should be obtained using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Carbon tetrachloride vapor is a narcotic and causes severe damage to the liver and kidneys. In animals the primary damage from intoxication is to the liver, but in humans the majority of fatalities have been the result of renal injury with secondary cardiac failure. In humans, liver damage occurs more often after ingestion of the

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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Occupational Safety and Health Administration

liquid than after inhalation of the vapor. Human fatalities from acute renal damage have occurred after exposure for @1/2 to 1 hour to concentrations of 1000 to 2000 ppm. Cardiac arrhythmias have been reported. Exposure to high concentrations results in symptoms of central nervous system depression, including dizziness, vertigo, incoordination, and mental confusion; abdominal pain, nausea, vomiting, and diarrhea are frequent. Polycythemia followed by anemia and hemodilution may occur. Within a few days, jaundice may appear and liver injury progress to toxic necrosis. At the same time, acute nephritis occurs, and albumin, red and white blood cells, and casts appear in the urine; there may be oliguria, anuria, and increased nitrogen retention resulting in the development of uremia. There are several reports of adverse effects in workmen who were repeatedly exposed to concentrations between 25 and 30 ppm; nausea, vomiting, dizziness, drowsiness, and headache were frequently noted. The effects of carbon tetrachloride in humans who are addicted to alcohol are more severe than usual. No adverse symptoms resulted from repeated exposure to 10 ppm. The liquid splashed in the eye causes pain and minimal injury to the conjunctiva. Prolonged or repeated skin contact with the liquid may result in skin irritation. It can be absorbed through the intact skin of animals and humans in toxic amounts. Hepatomas have been reported in several animal species and in man.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 153.8
2. Boiling point (760 mm Hg): 76.8 C (170 F)
3. Specific gravity (water = 1): 1.59
4. Vapor density (air = 1 at boiling point of carbon tetrachloride): 5.3
5. Melting point: −23 C (-9 F)
6. Vapor pressure at 20 C (68 F): 91 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.08
8. Evaporation rate (butyl acetate = 1): 12.8

- **Reactivity**

1. Conditions contributing to instability: None
2. Incompatibilities: Carbon tetrachloride reacts with chemically active metals such as sodium, potassium, and magnesium.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, chlorine, phosgene, and carbon monoxide) may be released when carbon tetrachloride decomposes.
4. Special precautions: Liquid carbon tetrachloride will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: Carbon tetrachloride has an odor threshold of approximately 50 ppm, according to the *Hygienic Guide.*
2. Eye Irritation Level: Grant states that carbon tetrachloride is slightly irritating to the eyes, but does not mention the concentrations at which irritation occurs. In addition, carbon tetrachloride is "strongly suspected of causing retrobulbar neuritis, optic neuritis, and optic atrophy."
3. Evaluation of Warning Properties: Since the odor threshold of carbon tetrachloride is well above the permissible exposure, and since no quantitative data are available relating its warning properties to air concentrations, carbon tetrachloride is considered as a substance with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of carbon tetrachloride. Each measurement to determine short-duration ceiling levels should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure. Each measurement to determine a one-hour ceiling should consist of a one-hour sample or a series of consecutive samples totalling one hour.

- **Peak Above Ceiling Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of carbon tetrachloride. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure carbon tetrachloride may be used. An analytical method for carbon tetrachloride is in the

NIOSH Manual of Analytical Methods, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid carbon tetrachloride.

• Clothing wet with liquid carbon tetrachloride should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of carbon tetrachloride from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the carbon tetrachloride, the person performing the operation should be informed of carbon tetrachloride's hazardous properties.

• Non-impervious clothing which becomes contaminated with liquid carbon tetrachloride should be removed promptly and not reworn until the carbon tetrachloride is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid carbon tetrachloride may contact the eyes.

SANITATION

• Skin that becomes wet with liquid carbon tetrachloride should be promptly washed or showered with soap or mild detergent and water to remove any carbon tetrachloride.

• Eating and smoking should not be permitted in areas where carbon tetrachloride is handled, processed, or stored.

• Employees who handle liquid carbon tetrachloride should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

• Areas in which exposure to carbon tetrachloride can occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to carbon tetrachloride may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of fluorocarbons for aerosols, refrigerants, and fire extinguishants	Material substitution; process enclosure; local exhaust ventilation; personal protective equipment
Use as an agricultural grain fumigant and pesticide	Material substitution; personal protective equipment
Use in polymer technology as reaction medium, catalyst, chain transfer agent, and solvent for resins; in organic synthesis for chlorination of organic compounds in soap perfumery and insecticide industries	Process enclosure; local exhaust ventilation
Use as an industrial solvent for rubber cements, cable and semiconductor manufacture, separation of xylene isomers as components to reduce flammability	Material substitution; process enclosure; local exhaust ventilation; personal protective equipment
Use as a laboratory solvent	Material substitution; personal protective equipment
Use in metal recovery and catalyst regeneration	Process enclosure; local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If carbon tetrachloride gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present

after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If carbon tetrachloride gets on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If carbon tetrachloride soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of carbon tetrachloride, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When carbon tetrachloride has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If carbon tetrachloride is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Carbon tetrachloride may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

REFERENCES

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 1, 1972.

RESPIRATORY PROTECTION FOR CARBON TETRACHLORIDE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
100 ppm or less	Any supplied-air respirator. Any self-contained breathing apparatus.
300 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 300 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Chlorobenzene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: C_6H_5Cl
- Synonyms: Monochlorobenzene; chlorobenzol; phenyl chloride; MCB
- Appearance and odor: Colorless liquid with a mild aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chlorobenzene is 75 parts of chlorobenzene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 350 milligrams of chlorobenzene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Chlorobenzene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Chlorobenzene may cause drowsiness, incoordination, and unconsciousness. It may also cause irritation of the eyes, nose, and skin. Exposure to high levels might also cause liver damage.

2. Long-term Exposure: Prolonged or repeated skin contact with chlorobenzene liquid may cause skin burns. Prolonged or repeated exposure to this chemical might also result in liver, kidney, or lung damage.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to chlorobenzene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to chlorobenzene at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from chlorobenzene exposure.

—Skin disease: Chlorobenzene can cause dermatitis on exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Chlorobenzene is known as a liver toxin in animals. The importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although chlorobenzene is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of chlorobenzene might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

Chlorobenzene vapor is a narcotic. Cats exposed to 8,000 ppm showed severe narcosis after ½ hour and died 2 hours after removal from exposure, but 660 ppm for 1 hour was tolerated. Exposed animals showed eye and nose irritation, drowsiness, incoordination, and coma followed by death from the most severe exposures. Several species of animals exposed to 1,000 ppm for 7 hours/day, 5 days/week over a period of 44 days showed histopathologic changes in the lungs, liver, and

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Occupational Safety and Health Administration

September 1978

dneys, but at 475 ppm there was only slight liver istopathology in guinea pigs. Toxicologic studies and xperience indicate that chlorobenzene does not cause he type of blood changes seen with benzene exposure. n man, eye and nasal irritation begin to occur at 200 pm, and at that level the odor is pronounced and npleasant; industrial experience indicates that occaonal short exposures are not likely to result in more han minor skin irritation, but prolonged or frequently epeated contact may result in skin burns. In one case of ccidental poisoning from ingestion of the liquid by a hild there was pallor, cyanosis, and coma, followed by omplete recovery. Occupational intoxication has not een reported.

CHEMICAL AND PHYSICAL PROPERTIES

Physical data

1. Molecular weight: 112.5
2. Boiling point (760 mm Hg): 132 C (270 F)
3. Specific gravity (water = 1): 1.1
4. Vapor density (air = 1 at boiling point of chlorobenzene): 3.9
5. Melting point: −44 C (-47 F)
6. Vapor pressure at 20 C (68 F): 8.8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): .05
8. Evaporation rate (butyl acetate = 1): 1

Reactivity

1. Conditions contributing to instability: Heat
2. Incompatibilities: Contact with strong oxidizers nay cause fires and explosions.
3. Hazardous decomposition products: Toxic gases nd vapors (such as hydrogen chloride, phosgene, and arbon monoxide) may be released in a fire involving hlorobenzene.
4. Special precautions: Liquid chlorobenzene will ttack some forms of plastics, rubber, and coatings.

Flammability

1. Flash point: 28.9 C (84 F) (closed cup)
2. Autoignition temperature: 638 C (1180 F)
3. Flammable limits in air, % by volume: Lower: 1.3; Jpper: 7.1
4. Extinguishant: Carbon dioxide; dry chemical, oam

Warning properties

According to both Deichmann and Gerarde and the AIHA *Hygienic Guide*, the odor of chlorobenzene is "barely perceptible" at 60 ppm, a concentration below hat of the permissible exposure. Chlorobenzene is considered to have good warning properties. It is an eye rritant, as stated by Patty, but the exact concentrations at which this irritation occurs are not mentioned.

MONITORING AND MEASUREMENT PROCEDURES

General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure chlorobenzene may be used. An analytical method for chlorobenzene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid chlorobenzene.
- Clothing wet with liquid chlorobenzene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of chlorobenzene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the chlorobenzene, the person performing the operation should be informed of chlorobenzene's hazardous properties.
- Any clothing which becomes wet with liquid chlorobenzene should be removed immediately and not

reworn until the chlorobenzene is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid chlorobenzene may contact the eyes.

SANITATION

• Skin that becomes wet with liquid chlorobenzene should be promptly washed or showered with soap or mild detergent and water to remove any chlorobenzene.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to chlorobenzene may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of phenol in synthesis of polymeric materials	Local exhaust ventilation
Use as an intermediate in manufacture of ortho- and para-nitrobenzenes for use in dye manufacture; manufacture of DDT, aniline, picric acid, beta-chloroanthraquinone, and other chemicals; manufacture of rubber adhesives and adhesives	Process enclosure
Use as fiber swelling agent and dye carrier in textile processing	Local exhaust ventilation
Use as tar and grease remover in cleaning and degreasing operations	Local exhaust ventilation
Use as solvent in surface coatings and surface coating removers	Process enclosure; local exhaust ventilation; personal protective equipment
Use as extractant in manufacture of diisocyanates, rubber, perfumes, and pharmaceuticals	Local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If chlorobenzene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If chlorobenzene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If chlorobenzene soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of chlorobenzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

If chlorobenzene has been swallowed, do not induce vomiting. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If chlorobenzene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. Chlorobenzene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of chlorobenzene vapors are permitted.

• Waste disposal method:

Chlorobenzene may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "Chlorobenzene," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

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• Patty, F. A. (ed.): *Toxicology*, Vol. II of *Industrial Hygiene and Toxicology* (2nd ed. rev.), Interscience, New York, 1963.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• von Oettingen, W. F.: *The Halogenated Aliphatic, Olefinic, Cyclic, Aromatic, and Aliphatic-Aromatic Hydrocarbons Including the Halogenated Insecticides, Their Toxicity and Potential Dangers*, U.S. Public Health Service Publication No. 414, U.S. Government Printing Office, Washington, D.C., 1955.

RESPIRATORY PROTECTION FOR CHLOROBENZENE

Condition	Minimum Respiratory Protection* Required Above 75 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2400 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 2400 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO. 315

CHLOROFORM
Revision C

Date August 1979

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CHLOROFORM
OTHER DESIGNATIONS: Trichloromethane, $CHCl_3$, COBEHN Spray-Clean Solvent (Trade name), CAS# 000 067 663
MANUFACTURER: Available from many suppliers, including Cobehn, Inc., 226 Passaic, Fairfield, NJ 07006

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Chloroform plus stabilizer* *0.5-1% ethyl alcohol or 0.025% amylene. **ACGIH (1979); labeled as a suspected carcinogen. NIOSH (1976) recommended a 2 ppm ceiling level and a suspected carcinogen classification when a high level of $CHCl_3$ by gavage was found to cause liver cancer in mice and kidney tumors in rats. NIOSH also warned of an increased toxic hazard with $CHCl_3$ when alcohol had been consumed. Current OSHA TLV remains at a 50 ppm ceiling limit.	ca 100	8-hr TWA 10 ppm** or 50 mg/m^3 Human, oral LDLo 140 mg/kg Rat, inhalation LCLo 8000 ppm/4 hr Rat (6-15 day preg) inhalation TCLo 100 ppm/7 hr (teratogenic)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C)	142 (61)	Specific gravity, 20/4 C	1.489
Vapor pressure at 20 C, mm Hg	159	Volatiles, %	ca 100
30 C, mm Hg	245	Evaporation rate (CCl_4=1)	1.18
Vapor density (Air=1)	4.13	Freezing point, deg F (C)	-82(-63.5)
Solubility in water at 25 C, %	0.8	Molecular weight	119.38

Appearance & Odor: Clear, colorless, volatile liquid with a characteristic "sweetish" etheral odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
None	--	None	--	--

Nonflammable material. Use extinguishing media appropriate for surrounding fire.
When this material is involved in a fire situation, firefighters should use self-contained breathing apparatus for protection against suffocating vapors and toxic and corrosive decomposition products.

SECTION V. REACTIVITY DATA

Chloroform is stable in a sealed container in the dark. Even when stabilized with ethanol, it develops acidity from prolonged exposure to air and light.
Thermal-oxidative decomposition at high temperature can generate toxic and corrosive oxides of chlorine and carbon, hydrogen chloride, and chlorine.
Avoid contact with strong alkalis.

Occupational Health Guideline for o-Dichlorobenzene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: 1,2-$C_6H_4Cl_2$
- Synonyms: 1,2-Dichlorobenzene; o-dichlorobenzol
- Appearance and odor: Colorless to pale yellow liquid with a pleasant aromatic odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for o-dichlorobenzene is a ceiling of 50 parts of o-dichlorobenzene per million parts of air (ppm). This may also be expressed as 300 milligrams of o-dichlorobenzene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

o-Dichlorobenzene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may also be absorbed through the skin.

- **Effects of overexposure**

1. Short-term Exposure: o-Dichlorobenzene vapor may cause irritation of the upper respiratory tract and eyes. Higher concentrations may cause drowsiness, unconsciousness, and death. The liquid may cause burning of the skin. The liquid may also cause burning of the eyes with tissue damage.

2. Long-term Exposure: Prolonged or repeated contact with o-dichlorobenzene may cause skin irritation. Prolonged or repeated inhalation of high concentrations of vapor might cause liver or kidney injury.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to o-dichlorobenzene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to o-dichlorobenzene at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from o-dichlorobenzene exposure.

—Liver disease: o-Dichlorobenzene is known as a liver toxin in animals. The importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: o-Dichlorobenzene is known as a kidney toxin in animals. The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Skin disease: o-Dichlorobenzene may cause sensitization dermatitis and blistering of the skin . Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

o-Dichlorobenzene vapor at high concentrations is toxic to the liver and kidneys in animals. Rats died from exposure to 977 ppm for 7 hours, but survived when exposed for only 2 hours; animals survived exposure to 539 ppm for 3 hours and at necropsy showed marked centrolobular necrosis of the liver, as well as cloudy swelling of the tubular epithelium of the kidneys. Several species of animals exposed repeatedly to 93 ppm for 7 hours daily showed no adverse effects. The liquid instilled in the rabbit eye produced apparent distress and slight conjunctival irritation. Eye irritation is not

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usually evident below 20 ppm but becomes noticeable at 25 to 30 ppm and painful to some at 60 to 100 ppm if exposures are for more than a few minutes duration. Some acclimatization may occur, but its extent is not great. Workers exposed daily to an average of 15 ppm showed no indication of injury. The liquid left on the skin may produce blistering. Sensitization dermatitis has been reported.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 147
  2. Boiling point (760 mm Hg): 180 C (356 F)
  3. Specific gravity (water = 1): 1.3
  4. Vapor density (air = 1 at boiling point of o-dichlorobenzene): 5.1
  5. Melting point: −17.6 C (0.5 F)
  6. Vapor pressure at 20 C (68 F): 1.2 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): 0.015
  8. Evaporation rate (butyl acetate = 1): Less than 1
- **Reactivity**
  1. Conditions contributing to instability: Heat.
  2. Incompatibilities: Contact with strong oxidizers or with hot aluminum or aluminum alloys may cause fires and explosions.
  3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, chlorine, and carbon monoxide) may be released in a fire involving o-dichlorobenzene.
  4. Special precautions: Liquid o-dichlorobenzene will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: 66 C (151 F) (closed cup)
  2. Autoignition temperature: 648 C (1198 F)
  3. Flammable limits in air, % by volume: Lower: 2.2; Upper: 9.2
  4. Extinguishant: Dry chemical, foam, carbon dioxide
- **Warning properties**
  1. Odor Threshold: 2 to 4 ppm, according to the AIHA *Hygienic Guide*; 50 ppm, according to May and Patty.
  2. Eye Irritation Level: 20 to 30 ppm according to the AIHA *Hygienic Guide.*
  3. Evaluation of Warning Properties: Since the odor threshold of o-dichlorobenzene and the concentration causing eye irritation are at or below the permissible exposure, it is treated as a material with adequate warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of o-dichlorobenzene. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure o-dichlorobenzene may be used. An analytical method for o-dichlorobenzene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6). ical Methods for Set J" (order number PB 263 959).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid o-dichlorobenzene.
- Clothing wet with liquid o-dichlorobenzene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of o-dichlorobenzene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the o-dichlorobenzene, the person performing the operation should be informed of o-dichlorobenzene's hazardous properties.

• Non-impervious clothing which becomes contaminated with liquid o-dichlorobenzene should be removed promptly and not reworn until the o-dichlorobenzene is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid o-dichlorobenzene may contact the eyes.

SANITATION

• Skin that becomes contaminated with liquid o-dichlorobenzene should be promptly washed or showered with soap or mild detergent and water to remove any o-dichlorobenzene.

• Employees who handle liquid o-dichlorobenzene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to o-dichlorobenzene may occur and control methods which may be effective in each case:

Operation	Controls
Use in cleaning and degreasing of metal, leather, wool, paper, dry cleaning, brick, and upholstery	General dilution ventilation; personal protective equipment
Use as fumigant for poultry houses and stockyards for termites, moths, and beetles	Personal protective equipment
Use in application or removal of surface coatings	General dilution ventilation; personal protective equipment
Use in maintenance of equipment containing heat-transfer agents	Personal protective equipment
Use in organic synthesis in pesticides, herbicides, dyestuffs, and pharmaceuticals; chemical intermediate in manufacture of toluene-diisocyanate and extractive distillation of ethyl benzene from xylene; use as a deodorizing agent	General dilution ventilation
Use in textile dyeing operations	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If liquid o-dichlorobenzene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If liquid o-dichlorobenzene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If liquid o-dichlorobenzene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of o-dichlorobenzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When o-dichlorobenzene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If o-dichlorobenzene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.

2. Ventilate area of spill or leak.

For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

• Waste disposal methods:

o-Dichlorobenzene may be disposed of:

1. By absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

2. By atomizing in a suitable combustion chamber equipped with an effluent gas cleaning device.

REFERENCES

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RESPIRATORY PROTECTION FOR o-DICHLOROBENZENE

Condition	Minimum Respiratory Protection* Required Above 50 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
1700 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 1700 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for p-Dichlorobenzene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: 1,4-$C_6H_4Cl_2$
- Synonyms: 1,4-Dichlorobenzene; dichlorocide; PDCB
- Appearance and odor: Colorless solid with a moth-ball-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for p-dichlorobenzene is 75 parts of p-dichlorobenzene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 450 milligrams of p-dichlorobenzene per cubic meter of air (mg/m³).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

p-Dichlorobenzene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

Exposure to p-dichlorobenzene may cause irritation of the eyes, nose, and throat. It may also cause headache, swelling around the eyes, and runny nose. In addition, it may cause loss of appetite, nausea, vomiting, weight loss, and liver damage with yellow jaundice and death. Particles of solid p-dichlorobenzene in contact with the eyes may cause pain. The solid material also produces a burning sensation when held in contact with the skin with slight irritation. Warm fumes or strong solutions of p-dichlorobenzene may irritate the skin slightly on prolonged or repeated contact. Red blotching of the skin due to allergy to p-dichlorobenzene may occur.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to p-dichlorobenzene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to p-dichlorobenzene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver, respiratory tract, eyes, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Since liver damage has been observed in humans exposed to p-dichlorobenzene, a profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Measurement of 2,5-dichlorophenol may serve as an index of exposure.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

p-Dichlorobenzene vapor irritates the eyes and upper respiratory tract and is toxic to the liver. A group of animals repeatedly exposed to 798 ppm developed eye irritation, marked tremors, weakness, and loss of weight; some died. Reversible, nonspecific changes in the eye grounds were noted in rabbits, but there were no lens changes; other effects were centrolobular necrosis of the liver and mild damage to the lungs and kidneys. In five cases of intoxication from exposure to p-dichlorobenzene used as a mothproofing agent, one person with only moderate exposure complained of severe headache, periorbital swelling, and profuse rhinitis, which subsided 24 hours after cessation of exposure.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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e other four persons who had more prolonged expo-
e developed anorexia, nausea, vomiting, weight loss,
l hepatic necrosis with jaundice; two died, and
ther developed cirrhosis. In 58 workers exposed for
verage of 4.8 years (range, 8 months to 25 years) to
ichlorobenzene at levels of 10 to 725 ppm, there was
evidence of hematologic effects; painful irritation of
eyes and nose was recorded at levels between 50 and
ppm, and it was severe at 160 ppm. Solid particles of
ichlorobenzene in the human eye cause pain. The
id material produces a burning sensation when held
contact with the skin, but the resulting irritation is
ht; warm fumes or strong solutions may irritate the
ct skin slightly on prolonged or repeated contact. A
e of allergic purpura induced by p-dichlorobenzene
been reported. In a study of workers engaged in
thesizing or otherwise handling p-dichlorobenzene,
vas concluded that urinary excretion of 2,5-dichloro-
enol (a metabolite of paradichlorobenzene) can serve
an index of exposure. Published studies of tests for
cinogenicity are considered to have been too short in
ation and involved too few animals to have any
nificance.

HEMICAL AND PHYSICAL PROPERTIES

Physical data

1. Molecular weight: 147
2. Boiling point (760 mm Hg): 174 C (345 F)
3. Specific gravity (water = 1): 1.46
4. Vapor density (air = 1 at boiling point of p-hlorobenzene): 5.1
5. Melting point: 53 C (127 F)
6. Vapor pressure at 20 C (68 F): 0.4 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 08
8. Evaporation rate (butyl acetate = 1): Not applica-

Reactivity

1. Conditions contributing to instability: None
2. Incompatibilities: None
3. Hazardous decomposition products: Toxic gases d vapors (such as hydrogen chloride and carbon noxide) may be released in a fire involving p-hlorobenzene.
4. Special precautions: Liquid p-dichlorobenzene ll attack some forms of plastics, rubber, and coatings.

Flammability

1. Flash point: 65.6 C (150 F) (closed cup)
2. Autoignition temperature: Data not available
3. Flammable limits in air, % by volume: Lower: 2.5 lculated at flash point)
4. Extinguishant: Foam, carbon dioxide, dry chemi-

Warning properties

1. Odor Threshold: Patty states that "p-dichloroben-ne has a very distinctive aromatic odor. The thresh-d of detection will vary from 15 to 30 ppm in air. The or becomes very strong at concentrations between 30 and 60 ppm .... It should be recognized, however, that a person may become sufficiently accustomed to the odor to tolerate high concentrations."
2. Irritation Levels: Patty states that p-dichlorobenzene "is painful to the eyes and nose at concentrations of 80 to 160 ppm. Above 160 ppm, it is intolerable to any person who has not worked in it long enough to have had some adaptation."
3. Evaluation of Warning Properties: Through its odor and irritant effects, p-dichlorobenzene can be detected within three times the permissible exposure limit. For the purposes of this guideline, therefore, it is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure p-dichlorobenzene may be used. An analytical method for p-dichlorobenzene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which

includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solid particles or vapors from the surface of hot p-dichlorobenzene.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where p-dichlorobenzene or liquids containing p-dichlorobenzene may contact the eyes.

SANITATION

- Workers subject to skin contact with p-dichlorobenzene should wash any areas of the body which may have contacted p-dichlorobenzene at the end of each work day.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to p-dichlorobenzene may occur and control methods which may be effective in each case:

Operation	Controls
Formulation for use in moth control; as a deordorant for garbage and rest rooms; as an insecticide for control of fruit borers and ants; use in organic synthesis for preparation of dye intermediates	General dilution ventilation; local exhaust ventilation; personal protective equipment
Manufacture of p-dichlorobenzene	General dilution ventilation; local exhaust ventilation; personal protective equipment
Application as an insecticide, air deordorant, moth and mildew preventive, and household fumigant	General dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If p-dichlorobenzene or liquids containing p-dichlorobenzene get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If p-dichlorobenzene or liquids containing p-dichlorobenzene get on the skin, wash the contaminated skin using soap or mild detergent and water. If p-dichlorobenzene or liquids containing p-dichlorobenzene penetrate through the clothing, remove the clothing and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of p-dichlorobenzene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

When p-dichlorobenzene has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.
- If p-dichlorobenzene is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. For small quantities, sweep onto paper or other suitable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dispose in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device as in below or deposit in a secured sanitary landfill.

- Waste disposal methods:

p-Dichlorobenzene may be disposed of:

1. By making packages of p-dichlorobenzene in paper or other flammable material and burning in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.
2. By dissolving p-dichlorobenzene in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

By disposal in a secured sanitary landfill.

REFERENCES

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RESPIRATORY PROTECTION FOR p-DICHLOROBENZENE

Condition	Minimum Respiratory Protection* Required Above 75 ppm
Vapor Concentration	
1,000 ppm or less	A chemical cartridge respirator with a full facepiece, an organic vapor cartridge(s), and dust filter. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust filter. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 1,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for 1,1-Dichloroethane

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_3CHCl_2
- Synonyms: Asymmetrical dichloroethane; ethylidene chloride; 1,1-ethylidene dichloride
- Appearance and odor: Colorless liquid with a chloroform-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1-dichloroethane is 100 parts of 1,1-dichloroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 400 milligrams of 1,1-dichloroethane per cubic meter of air (mg/m^3). The American Conference of Governmental Industrial Hygienists has recommended for 1,1-dichloroethane a Threshold Limit Value of 200 ppm.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

1,1-Dichloroethane can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Breathing 1,1-dichloroethane vapor may cause drowsiness and unconsciousness. It might also cause damage to the liver, kidneys, and lungs. Splashing the liquid in the eyes may cause irritation.

2. Long-term Exposure: Prolonged, confined, or repeated skin contact with 1,1-dichloroethane can produce a slight burn.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,1-dichloroethane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 1,1-dichloroethane at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,1-dichloroethane exposure.

—Skin disease: 1,1-Dichloroethane can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver disease: Although 1,1-dichloroethane is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Kidney disease: Although 1,1-dichloroethane is not known as a kidney toxin in humans, the importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 1,1-dichloroethane might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

1,1-Dichloroethane vapor is a narcotic. Rats exposed to 32,000 ppm for 30 minutes did not survive. The most consistent findings in animals exposed to concentrations

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of above 8,000 ppm for up to 7 hours were pathologic changes in the kidney and liver, and at much higher concentrations, near 64,000 ppm, damage to the lungs as well. Repeated daily exposure of several species of animals to 1,000 ppm resulted in no pathologic or hematologic changes. The liquid applied to the intact or abraded skin of rabbits produced slight edema and very slight necrosis after six daily applications. Instilled in the eyes of rabbits there was immediate, moderate conjunctival irritation and swelling which subsided within a week. There have been no reported cases of human overexposure by inhalation; prolonged, confined, or repeated skin contact can produce a slight burn.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 99
  2. Boiling point (760 mm Hg): 57.3 C (135 F)
  3. Specific gravity (water = 1): 1.2
  4. Vapor density (air = 1 at boiling point of 1,1-dichloroethane): 3.4
  5. Melting point: −96.7 C (−142 F)
  6. Vapor pressure at 20 C (68 F): 182 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): Less than 0.1
  8. Evaporation rate (butyl acetate = 1): 11.6
- **Reactivity**
  1. Conditions contributing to instability: Heat
  2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong caustics will cause formation of flammable and toxic acetaldehyde gas.
  3. Hazardous decomposition products: Toxic gases and vapors (such as vinyl chloride, hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving 1,1-dichloroethane.
  4. Special precautions: 1,1-Dichloroethane will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: −8.5 C (17 F) (closed cup)
  2. Autoignition temperature: Data not available
  3. Flammable limits in air, % by volume: Lower: 5.9; Upper: 15.9
  4. Extinguishant: Foam, dry chemical, carbon dioxide
- **Warning properties**

The AIHA *Hygienic Guide* reports that 1,1-dichloroethane has a distinctive, easily recognizable odor at the TLV.

1,1-Dichloroethane is not known to be an eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

- **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 1,1-dichloroethane may be used. An analytical method for 1,1-dichloroethane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 1,1-dichloroethane.
- Clothing wet with liquid 1,1-dichloroethane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,1-dichloroethane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 1,1-dichloroethane, the person performing the operation should be informed of 1,1-dichloroethane's hazardous properties.
- Any clothing which becomes wet with liquid 1,1-dichloroethane should be removed immediately and not

reworn until the 1,1-dichloroethane is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid 1,1-dichloroethane may contact the eyes.

SANITATION

• Skin that becomes wet with liquid 1,1-dichloroethane should be immediately washed or showered with soap or mild detergent and water to remove any 1,1-dichloroethane.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,1-dichloroethane may occur and control methods which may be effective in each case:

Operation	Controls
Use as dewaxer of mineral oils; extractant for heat-sensitive substances	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a fumigant	General dilution ventilation of work area; personal protective equipment
Use in manufacture of vinyl chloride by vapor phase cracking; use in manufacture of high vacuum rubber and silicon grease; use as a chemical intermediate	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If 1,1-dichloroethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If 1,1-dichloroethane gets on the skin, promptly flush the contaminated skin using soap or mild detergent and water. If 1,1-dichloroethane soaks through the clothing, remove the clothing immediately and flush the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of 1,1-dichloroethane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When 1,1-dichloroethane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If 1,1-dichloroethane is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. 1,1-Dichloroethane should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of 1,1-dichloroethane vapors are permitted.

• Waste disposal method:

1,1-Dichloroethane may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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RESPIRATORY PROTECTION FOR 1,1-DICHLOROETHANE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
4000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
Greater than 4000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for 1,2-Dichloroethylene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: ClCH=CHCl
- Synonyms: Acetylene dichloride; dioform; trans-acetylene dichloride; sym-dichloroethylene
- Appearance and odor: Colorless liquid with an ether-like, slightly acrid odor, like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,2-dichloroethylene is 200 parts of 1,2-dichloroethylene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 790 milligrams of 1,2-dichloroethylene per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

1,2-Dichloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

Exposure to 1,2-dichloroethylene may cause dizziness, drowsiness, and unconsciousness.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,2-dichloroethylene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 1,2-dichloroethylene at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,2-dichloroethylene exposure.

—Liver disease: Although 1,2-dichloroethylene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Chronic respiratory disease: In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 1,2-dichloroethylene might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

1,2-Dichloroethylene vapor is a narcotic and a mucous-membrane irritant. Variations in toxicity of the cis- as compared with the trans-form have been reported. A concentration of 39,000 ppm was lethal to guinea pigs, and narcosis was produced at 18,000 ppm. Dogs exposed to high concentrations of vapor developed superficial corneal turbidity which was reversible. No effects were observed in several species with repeated exposure for up to 6 months at 1000 ppm. It has been used as a general anesthetic in man; one industrial fatality was due to very high vapor inhalation in a small enclosure.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 96.9
2. Boiling point (760 mm Hg): 45 to 60 C (113 to 140 F)
3. Specific gravity (water = 1): 1.27
4. Vapor density (air = 1 at boiling point of 1,2-dichloroethylene): 3.34
5. Melting point: −49 to −81.5 C (−56 to −115 F)
6. Vapor pressure at 20 C (68 F): 180 to 265 mm Hg

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7. Solubility in water, g/100 g water at 20 C (68 F): 0.35 to 0.63

8. Evaporation rate (butyl acetate = 1): Data not available

• **Reactivity**

1. Conditions contributing to instability: Heat

2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving 1,2-dichloroethylene.

4. Special precautions: 1,2-Dichloroethylene will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Flash point: 2.2 to 3.9 C (36 to 39 F) (closed cup)

2. Autoignition temperature: 460 C (860 F) for trans-1,2-dichloroethylene

3. Flammable limits in air, % by volume: Lower: 9.7; Upper: 12.8

4. Extinguishant: Dry chemical, foam, carbon dioxide

• **Warning properties**

May reports an odor threshold of 0.085 ppm for dichloroethylene. For the purposes of this guideline, 1,2-dichloroethylene is treated as a material with adequate warning properties.

1,2-Dichloroethylene is an eye irritant, according to Grant, but the concentrations at which irritation occurs are not mentioned.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

Sampling and analyses may be performed by collection of 1,2-dichloroethylene vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 1,2-dichloroethylene may be used. An analytical method for 1,2-dichloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 2, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00260-6).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 1,2-dichloroethylene.

• Clothing wet with liquid 1,2-dichloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,2-dichloroethylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 1,2-dichloroethylene, the person performing the operation should be informed of 1,2-dichloroethylene's hazardous properties.

• Any clothing which becomes wet with liquid 1,2-dichloroethylene should be removed immediately and not reworn until the 1,2-dichloroethylene is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid 1,2-dichloroethylene may contact the eyes.

SANITATION

• Skin that becomes wet with liquid 1,2-dichloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any 1,2-dichloroethylene.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,2-dichloroethylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as a low-temperature solvent for heat-sensitive substances in extraction of caffeine, perfume oils, and fats from flesh of animals	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in rubber and dye industries in extraction and application	Process enclosure; local exhaust ventilation; personal protective equipment
Use as a direct solvent in gums, waxes, oils, camphor, and phenol; use in solvent mixtures for esters and ether derivatives, lacquers, resins, thermoplastics, and artificial fibers	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Use in organic synthesis for polymers and telomers	Process enclosure; local exhaust ventilation; personal protective equipment
Use in miscellaneous applications as liquid dry cleaning agent, cleaning solution for printed circuit boards, food packaging adhesives, and germicidal fumigants	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If 1,2-dichloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If 1,2-dichloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 1,2-dichloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of 1,2-dichloroethylene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When 1,2-dichloroethylene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If 1,2-dichloroethylene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device. 1,2-Dichloroethylene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of 1,2-dichloroethylene vapors are permitted.

• Waste disposal method:

1,2-Dichloroethylene may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device.

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RESPIRATORY PROTECTION FOR 1,2-DICHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
4000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 4000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
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GENIUM PUBLISHING CORP.

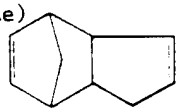
NO. 340

DICYCLOPENTADIENE
Revision B

DATE February 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: DICYCLOPENTADIENE
DESCRIPTION: A higher purity, inhibited grade; low melting crystals or liquid.
OTHER DESIGNATIONS: DCPD, Cyclopentadiene Dimer, 3a,4,7,7a-Tetrahydro-4,7-methanoindene (endo- and exo-isomers), $C_{10}H_{12}$, CAS #000 077 736, DCPD-97 (EXXON Tradename)
MANUFACTURER: Available from several suppliers, including:
EXXON Chemical Americas
P.O. Box 3272
Houston, TX 77001 Phone: (713) 870-6000



SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Dicyclopentadiene*	>93	8-hr TWA
Cyclopentadiene	<4	5 ppm or 30 mg/m^3**
Inhibitor (such as 100-200 ppm p-t-Butylcatechol) (MSDS #421)	-	75 ppm or 200 mg/m^3
Impurities can include:		
C_5 Acyclic dienes, (<2.5%)		Rat, Oral
Methylcyclopentadiene (<2.5%)		LD_{50} 353 mg/kg
		Rat, Inhalation
*Commercial material is mainly the endo-isomer.		LCLo 500 ppm/4Hr
Total DCPD plus cyclopentadiene is >97%.		LC_{50} 660 ppm/4Hr
**ACGIH (1983) TLV. No OSHA PEL.		Rabbit, Eye
		500 mg/24 Hr Mod.Irr.
		Rabbit, Skin
		LD_{50} 5g/kg

SECTION III. PHYSICAL DATA

Boiling range, 1 atm, deg C ------	56-173*	Specific gravity, 20/20 C -----	∿0.98
Vapor pressure at 25 C, mm Hg ----	2-40*	Melting point, deg C ----------	16-33*
Vapor density (Air=1) ----------	∿4.4	Evaporation rate (n-BuAc=1) ---	<0.1
Solubility in water ----------	Negligible	Volatiles, % ----------	<7
		Molecular weight (dimer) ------	132.2

Appearance & Odor: Colorless, as crystals when nearly pure* or as a liquid; it has a camphor-like odor with a 100% recognition threshold of 0.02 ppm. Material has good warning properties, but may not be noticeably irritating below 10 ppm.

*Pure DCPD: B.P. ∿170 C (depolymerizes); M.P. 33.6 C; Vap Pres. at 25C, 2.2 mm Hg

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
>35 F (TCC)*	N/A	N/A		

Extinguishing media: Dry chemical, carbon dioxide, alcohol foam, water fog. Use a water spray to cool surroundings and fire-exposed containers. (Possible pressure rupture of containers from heating and depolymerization.)
Material is a fire hazard and a possible explosion hazard if exposed to heat or flames. Firefighters should use self-contained breathing apparatus.

*Pure DCPD Fl. Pt. >76 F (TCC)

SECTION V. REACTIVITY DATA

At room temperature in stainless steel container under inert atmosphere the inhibited material is fairly stable (>2 month shelf-life with negligible change). It does not undergo hazardous polymerization. At about 170C DCPD depolymerizes to cyclopentadiene.
This flammable material (OSHA Class IB) is incompatible with oxidizing agents.
In contact with air, especially when heated, DCPD forms peroxides; the level of these is controlled by the inhibitor (until exhausted). Alkaline solutions can extract inhibitor from DCPD. Avoid forming peroxide-rich distillation bottoms! Cool still bottoms under inert atmosphere.

Thermal-oxidative degradation products can include cyclopentadiene, partial oxidation products, CO and CO_2.

Occupational Health Guideline for Endrin

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{12}H_8Cl_6O$
- Synonyms: 1,2,3,4,10,10-Hexachloro-6,7-epoxy-1,4,4a,5,6,7,8,8a-octahydro-1,4-endo-endo-5,8-dimethanonaphthalene
- Appearance and odor: Colorless to tan solid with a mild chemical odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for endrin is 0.1 milligram of endrin per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Endrin can affect the body if it is inhaled, comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

Exposure to endrin may cause sudden convulsions which may occur from 30 minutes to 10 hours after exposure. Headache, dizziness, sleepiness, weakness, and loss of appetite may be present for two to four weeks following this exposure. A number of deaths have occurred from swallowing endrin. In less severe cases of endrin poisoning, the complaints include headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, agitation, and mental confusion. Experimental feeding of endrin to animals has produced abnormalities in their offspring.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to endrin.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to endrin at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of convulsive disorders would be expected to be at increased risk from exposure. Examination of the nervous system and liver should be stressed. The concentration of endrin in the blood is helpful in determining the extent of absorption.

2. Periodic Medical Examination: The aforementioned medical examination should be repeated on an annual basis.

- **Summary of toxicology**

Endrin as the dust or in solution is a convulsant. Single doses of 2.5 mg/kg of endrin administered orally to pregnant golden hamsters during the period of fetal organogenesis caused a high incidence of fetal deaths, congenital anomalies, and growth retardation. Rats fed a diet of 50 or 100 ppm endrin for 2 years developed degenerative changes in the liver. In humans, the first effect of endrin intoxication is frequently a sudden epileptiform convulsion, which may occur from 30 minutes to up to 10 hours after overexposure; it lasts for several minutes and is usually followed by a stuporous state for 15 minutes to 1 hour. The electroencephalogram may show dysrhythmic changes which frequently precede convulsions; withdrawal from exposure usually results in a normal electroencephalogram within 1 to 6 months. In most cases recovery is rapid, but headache, dizziness, lethargy, weakness, and anorexia may persist

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Occupational Safety and Health Administration

for 2 to 4 weeks. In less severe cases of endrin intoxication, the complaints are headache, dizziness, abdominal discomfort, nausea, vomiting, insomnia, agitation and, occasionally, slight mental confusion. There are numerous reports of fatalities from ingestion of endrin. In one nonfatal incident, ingestion of bread made with endrin-contaminated flour resulted in sudden convulsions in three people; in one person the serum endrin level was 0.053 ppm 30 minutes after the convulsion and 0.038 ppm after 20 hours; in the other two cases no endrin was detected in the blood at 8.5 or 19 hours, respectively, after convulsions.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 380.9
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.7
4. Vapor density (air = 1 at boiling point of endrin): Not applicable
5. Melting point: 200 C (392 F) decomposes
6. Vapor pressure at 20 C (68 F): 0.0000002 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 160 ppb
8. Evaporation rate (butyl acetate = 1): Not applicable

- **Reactivity**

1. Conditions contributing to instability: Temperatures above 200 C (392 F) cause a chemical change that gives off heat and may cause containers to burst. If a solvent is present, flammable vapors may be formed from it.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions. Contact with strong acids may cause evolution of heat and formation of explosive solvent vapors.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, other volatile chlorinated compounds, and carbon monoxide) may be released when endrin decomposes.
4. Special precautions: None

- **Flammability**

1. Solid not combustible; may be dissolved in flammable solvent

- **Warning properties**

Since the vapor pressure of endrin is negligible, warning properties are not considered.
Endrin is not known to be an eye irritant.

MONITORING AND MEASUREMENT PROCEDURES

General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Method**

An analytical method for endrin is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 6, 1980, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00369-6).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent any possibility of skin contact with endrin or liquids containing endrin.
- If employees' clothing has had any possibility of being contaminated with endrin or liquids containing endrin, employees should change into uncontaminated clothing before leaving the work premises.
- Clothing which has had any possibility of being contaminated with endrin should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of endrin from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the endrin, the person performing the operation should be informed of endrin's hazardous properties.
- Where there is any possibility of exposure of an employee's body to endrin or liquids containing endrin, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.
- Non-impervious clothing which becomes contaminated with endrin should be removed immediately and not reworn until the endrin is removed from the clothing.
- Employees should be provided with and required to use dust- and splash-proof safety goggles where there is

any possibility of endrin or liquids containing endrin contacting the eyes.

• Where there is any possibility that employees' eyes may be exposed to endrin, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Skin that becomes contaminated with endrin should be immediately washed or showered with soap or mild detergent and water to remove any endrin.

• Workers subject to skin contact with endrin or liquids containing endrin should wash with soap or mild detergent and water any areas of the body which may have contacted endrin at the end of each work day.

• Eating and smoking should not be permitted in areas where endrin or liquids containing endrin are handled, processed, or stored.

• Employees who handle endrin or liquids containing endrin should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to endrin may occur and control methods which may be effective in each case:

Operation	Controls
Application as an insecticide on cotton fields and vegetable crops, and as a rodenticide against mice and chipmunks in orchards	Personal protective equipment
Formulation for use as an insecticide and rodenticide	Local exhaust ventilation; general dilution ventilation; personal protective equipment
Manufacture of endrin	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If endrin or liquids containing endrin get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If endrin or liquids containing endrin get on the skin, immediately wash the contaminated skin using soap or mild detergent and water. If endrin or liquids containing endrin penetrate through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. Get medical attention promptly.

• **Breathing**

If a person breathes in large amounts of endrin, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When endrin or liquids containing endrin have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If endrin is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation, or for disposal in a secured sanitary landfill. Liquid containing endrin should be absorbed in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Endrin may be disposed of in sealed containers in a secured sanitary landfill.

ADDITIONAL INFORMATION

To find additional information on endrin, look up endrin in the following documents:

• Medical Surveillance for Chemical Hazards
• Respiratory Protection for Chemical Hazards
• Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

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- *Survey of Compounds Which Have Been Tested for Carcinogenic Activity*, U.S. Public Health Service Publication No. 149, Original, Supplements 1 and 2, 1961-1967, 1968-1969, and 1970-1971.

RESPIRATORY PROTECTION FOR ENDRIN

Condition	Minimum Respiratory Protection* Required Above 0.1 mg/m³
Particulate Concentration	
1 mg/m³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator. Any self-contained breathing apparatus.
5 mg/m³ or less	A chemical cartridge respirator with a full facepiece, organic vapor cartridge(s), and dust and mist filter(s), including pesticide respirators which meet the requirements of this class. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust and mist filter, including pesticide respirators which meet the requirements of this class. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
100 mg/m³ or less	A powered air-purifying respirator with an organic vapor cartridge and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class. A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode.
200 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 200 mg/m³** or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**Use of supplied-air suits may be necessary to prevent skin contact while providing respiratory protection from airborne concentrations of endrin; however, this equipment should be selected, used, and maintained under the immediate supervision of trained personnel. Where supplied-air suits are used above a concentration of 200 mg/m³, an auxiliary self-contained breathing apparatus operated in positive pressure mode should also be worn.

Occupational Health Guideline for Methylene Chloride

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: CH_2Cl_2
- Synonyms: Dichloromethane; methylene dichloride
- Appearance and odor: Colorless liquid with an odor like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for methylene chloride is 500 parts of methylene chloride per million parts of air (ppm) averaged over an eight-hour work shift, with an acceptable ceiling level of 1000 ppm and a maximum peak concentration of 2000 ppm for 5 minutes in any two-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 75 ppm averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 500 ppm averaged over a 15-minute period. NIOSH further recommends that permissible levels of methylene chloride be reduced where carbon monoxide is present. The NIOSH Criteria Document for Methylene Chloride should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Methylene chloride can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Methylene chloride is an anesthetic. Inhaling the vapor may cause mental confusion, light-headedness, nausea, vomiting, and headache. Continued exposure may cause increased light-headedness, staggering, unconsciousness, and death. High vapor concentrations may also cause irritation of the eyes and respiratory tract. Exposure to this chemical may make the symptoms of angina worse. Skin exposure to the liquid may cause irritation. If the liquid is held in contact with the skin, it may cause skin burns. Splashes of the liquid into the eyes may cause irritation.

2. Long-term Exposure: Prolonged or repeated exposure to methylene chloride may cause irritation of the skin.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to methylene chloride.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to methylene chloride at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the employee at increased risk, and to establish a baseline for future health monitoring. Examination of the skin, liver, kidneys, cardiovascular system, and blood should be stressed. Clinical impressions of the autonomic nervous system and pulmonary function should be made, with additional tests conducted where indicated.

—Skin disease: Methylene chloride can cause dermatitis on prolonged exposure. Persons with pre-existing skin disorders may be more susceptible to the effects of this agent.

—Liver function test: Methylene chloride causes liver damage in animals and this justifies consideration before exposing persons with impaired liver function. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

—Kidney disease: Methylene chloride causes kidney damage in animals and this justifies special considera-

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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tion before exposing persons with impaired renal function.

—Cardiovascular disease: Because of reports of excessive carbon monoxide levels following exposure to methylene chloride, persons with cardiac disease may be at increased risk.

—A complete blood count: A complete blood count should be performed, including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit. Carboxyhemoglobin values should also be determined periodically, and any level above 5% should prompt an investigation of the worker and his workplace.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

• **Summary of toxicology**

Methylene chloride vapor is a mild narcotic. Exposure of animals to 15,000 ppm for 7 hours was fatal. Animal experiments have shown that continuous exposure to 1,000 ppm can be lethal in 5 to 7 weeks for dogs and that fatty livers, icterus, pneumonia, and splenic atrophy developed in dogs. Cardiac arrhytmias attributed to sensitization of the myocardium have been observed following exposure to high concentrations of some chlorinated hydrocarbons, but dogs exposed to 10,000 and 20,000 ppm of methylene chloride did not show this phenomenon. In human experiments, inhalation of 500 to 1000 ppm for 1 to 2 hours resulted in lightheadedness; there was sustained elevation of carboxyhemoglobin level. High exposures have resulted in deaths in industrial situations. Lower but unknown concentrations have caused such symptoms as lightheadedness, weakness, nausea, and "drunken behavior," resulting in mistakes and accidental falls. Phosgene poisoning has been reported to occur in several cases where methylene chloride was used in the presence of an open fire. Liquid methylene chloride is irritating to the skin on repeated contact. Splashed in the eye, it is painfully irritating, but is not likely to cause serious injury.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 84.9
2. Boiling point (760 mm Hg): 39.8 C (104 F)
3. Specific gravity (water = 1): 1.3
4. Vapor density (air = 1 at boiling point of methylene chloride): 2.9
5. Melting point: −97 C (−142 F)
6. Vapor pressure at 20 C (68 F): 350 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1.32
8. Evaporation rate (butyl acetate = 1): 27.5

• **Reactivity**

1. Conditions contributing to instability: Heat and moisture
2. Incompatibilities: Contact with strong oxidizers, strong caustics, and chemically active metals such as aluminum or magnesium powder, sodium and potassium may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving methylene chloride.
4. Special precautions: Liquid methylene chloride will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Flash point: None with normal test method
2. Autoignition temperature: 556 C (1033 F)
3. Flammable limits in air, % by volume: (at elevated temperatures) Lower: 12; Upper: 19
4. Extinguishant: Dry chemical, carbon dioxide, foam

• **Warning properties**

1. Odor Threshold: Different authors have reported varying odor thresholds for methylene chloride. Summer and May both report 150 ppm; Kirk-Othmer and Sax both report 25 to 50 ppm; Spector reports 320 ppm. Patty, however, states that since one can become adapted to the odor, it cannot be considered an adequate warning property.
2. Eye Irritation Level: Grant reports that methylene chloride "presents no particular hazard to the eyes." Kirk-Othmer, however, reports that "methylene chloride vapor is seriously damaging to the eyes." Sax agrees with Kirk-Othmer's statement.

The *Documentation of TLV's* states that irritation of the eyes has been observed in workers who had been exposed to concentrations up to 5000 ppm, but that neurasthenic disorders were found in 50% and digestive disturbances in 30% of the persons exposed.

3. Other Information: Gleason reports that methylene chloride may be "irritating to the respiratory tract and may produce pulmonary edema" but gives no quantitative information. The *Documentation of TLV's* reports that in one investigation, irritation of the respiratory passages was observed in workers who had been exposed to concentrations up to 5000 ppm.
4. Evaluation of Warning Properties: Since no detailed information is available relating the irritant effects of methylene chloride to air concentrations and since adaptation to the odor occurs, methylene chloride is treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of methylene chloride. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Peak Above Ceiling Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of methylene chloride. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure methylene chloride may be used. An analytical method for methylene chloride is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid methylene chloride.

• Non-impervious clothing which becomes wet with liquid methylene chloride should be removed promptly and not reworn until the methylene chloride is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid methylene chloride may contact the eyes.

SANITATION

• Skin that becomes wet with liquid methylene chloride should be promptly washed or showered with soap or mild detergent and water to remove any methylene chloride.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to methylene chloride may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in paint and varnish removers; manufacture of aerosols; cold cleaning and ultrasonic cleaning; and as an extraction solvent for foods and furniture processing	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a cooling solvent in manufacture of cellulose acetate; in organic synthesis; and in plastics processing	Process enclosure; local exhaust ventilation
Use as a solvent in vapor degreasing of thermal switches and thermometers	Process enclosure; local exhaust ventilation
Use as a secondary refrigerant in air conditioning and scientific testing	General dilution ventilation; local exhaust ventilation; personal protective equipment

Occupational Health Guideline for Malathion

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_{10}H_{19}O_6PS_2$
- Synonyms: O,O-Dimethyl dithiophosphate of diethyl mercaptosuccinate; O,O-dimethyl S-(1,2-dicarbethoxyethyl) phosphorodithiocite
- Appearance and odor: Colorless to brown liquid with a mild skunk-like odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for malathion is 15 milligrams of malathion per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. NIOSH has recommended a permissible exposure limit of 15 mg/m^3 averaged over a work shift of up to ten hours per day, forty hours per week. The NIOSH Criteria Document for Malathion should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Malathion can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Malathion is one the least toxic of the organophosphate insecticides. Very large exposures are required to cause symptoms. After inhalation of malathion, breathing and eye effects are the first to appear. These include tightness of the chest, wheezing, a bluish discoloration of the skin, small pupils, aching in and behind the eyes, blurring of the vision, tearing, runny nose, headache, and watering of the mouth. After swallowing malathion, loss of appetite, nausea, vomiting, abdominal cramps and diarrhea may appear within two hours. After skin absorption, sweating and twitching in the area of absorption may occur, usually within 15 minutes to four hours. With severe intoxication by all routes, in addition to the above symptoms, weakness, generalized twitching and paralysis may occur and breathing may stop. In addition, dizziness, confusion, staggering, slurred speech, generalized sweating, irregular or slow heartbeat, convulsions, and coma may occur.

2. Long-term Exposure: Repeated exposure to malathion may make a person more susceptible to the effects of this and related chemicals.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to malathion.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to malathion at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Persons with a history of reduced pulmonary function or recent exposure to anticholinesterase agents would be expected to be at increased risk from exposure. Examination of the respiratory system, liver, and attention to the cholinesterase levels in the blood should be stressed.

—Cholinesterase determination: Malathion can cause depressed levels of activity of cholinesterase in the serum and erythrocytes. The cholinesterase activity in the erythrocytes should be measured by using medically acceptable biochemical tests before employment (or exposure) in order to establish an individual baseline

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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value, which should be the mean of two ChE activity measurements, taken at least one day apart.

—14" x 17" chest roentgenogram: Malathion causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Malathion is a respiratory irritant. Persons with impaired pulmonary function may be at increased risk from exposure. Periodic surveillance is indicated.

—Liver function tests: Malathion may cause liver damage. A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis, with the exception of the cholinesterase determination which should be performed quarterly or at any time overexposure is suspected or signs and symptoms of toxicity occur.

• **Summary of toxicology**

Malathion is a mild anticholinesterase agent; absorption may occur from inhalation of the mist, from skin absorption of solutions, or from ingestion. Malathion is less toxic to humans than most anticholinesterase agents because it is metabolized in the liver to an inactive form. However, ingestion of 50 to 90 cc of a 50% solution of malathion in a petroleum hydrocarbon base caused severe intoxication; the human LD50 is estimated to be about 1 g/kg. Signs and symptoms of intoxication by anticholinesterase agents are caused by the inactivation of the enzyme cholinesterase, which results in the accumulation of acetylcholine at synapses in the nueromuscular system, and secretory glands. After inhalation of extremely high concentrations, respiratory and ocular effects may appear simultaneously. Respiratory effects include tightness in the chest, wheezing, laryngeal spasms, and excessive salivation. Ocular effects include miosis, aching in and behind the eyes (attributed to ciliary spasm), blurring of distant vision, tearing, rhinorrhea, and frontal headache. After ingestion, gastrointestinal effects such as anorexia, nausea, vomiting, abdominal cramps, and diarrhea appear. Effects on the central nervous system may include giddiness, confusion, ataxia, and slurred speech. In a group of workers with maximum exposure of 56 mg/m^3 for 5 hours and an average of 3.3 mg/m^3, the cholinesterase levels in the blood were not significantly lowered and no one exhibited signs of cholinesterase inhibition. In a human experiment in which 4 men were exposed 1 hour daily for 42 days to 84.8 mg/m^3, there was moderate irritation of nose and conjunctiva but there were no cholinergic signs or symptoms.

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1. Molecular weight: 330
2. Boiling point (760 mm Hg): Decomposes
3. Specific gravity (water = 1): 1.23
4. Vapor density (air = 1 at boiling point of malathion): Not applicable
5. Melting point: 2.8 C (37 F)
6. Vapor pressure at 20 C (68 F): 0.00004 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 0.0145
8. Evaporation rate (butyl acetate = 1): Not applicable

• **Reactivity**

1. Conditions contributing to instability: Starts to decompose at 49 C (140 F) but is not hazardous.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as sulfur dioxide, phosphoric acid mist, and carbon monoxide) may be released in a fire involving malathion.
4. Special precautions: Malathion will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Not combustible.

• **Warning properties**

Since malathion has a negligible vapor pressure, warning properties are not considered.

Grant states that "undiluted technical liquid malathion dropped on a rabbits's eye caused slight immediate irritation with conjunctival hyperemia and edema of the lids, but the eye returned to normal in twenty-four hours."

The *Documentation of TLV's* notes that workers exposed to 84.8 mg/m^3 experienced moderate eye irritation.

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

An analytical method for malathion is in the *NIOSH Manual of Analytical Methods,* 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not

technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with malathion.

• Non-impervious clothing which becomes contaminated with malathion should be removed promptly and not reworn until the malathion is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid malathion may contact the eyes.

• Where there is any possibility that employees' eyes may be exposed to malathion, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

• Skin that becomes contaminated with malathion should be promptly washed or showered with soap or mild detergent and water to remove any malathion.

• Employees who handle malathion should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

• Eating and smoking should not be permitted in areas where malathion is handled, processed, or stored.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to malathion may occur and control methods which may be effective in each case:

Operation	Controls
Formulation of pesticide products	Process enclosure; local exhaust ventilation; personal protective equipment
Application as an insecticide for treatment of grain, nut, fruit, and fiber crops; grasses, seeds, and tobacco; animals; agricultural premises	Personal protective equipment
Manufacture of malathion	Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If malathion or formulations containing malathion get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If malathion or formulations containing malathion get on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If malathion or formulations containing malathion penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. Get medical attention immediately.

• **Breathing**

If a person breathes in large amounts of malathion, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When malathion or formulations containing malathion have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and

know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If malathion is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Malathion may be disposed of by absorbing in vermiculite, dry sand, earth, or a similar material and disposing in sealed containers in a secured sanitary landfill.

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RESPIRATORY PROTECTION FOR MALATHION

Condition	Minimum Respiratory Protection* Required Above 15 mg/m³
Particulate or Vapor Concentration	
150 mg/m³ or less	Any chemical cartridge respirator with an organic vapor cartridge(s) and dust, fume, and mist filter(s), including pesticide respirators which meet the requirements of this class.** Any supplied-air respirator.** Any self-contained breathing apparatus.**
750 mg/m³ or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and dust, fume, and mist filter(s), including pesticide respirators which meet the requirements of this class. A gas mask with a chin-style or a front- or back-mounted organic vapor canister and dust, fume, and mist filter(s), including pesticide respirators which meet the requirements of this class. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
5000 mg/m³ or less	A powered chemical cartridge respirator with a full facepiece, helmet, or hood, an organic vapor cartridge, and high efficiency particulate filter, including pesticide respirators which meet the requirements of this class. A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 5000 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors and particulates. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**If an employee informs his employer that he is experiencing eye irritation from malathion while wearing a half- or quarter-mask respirator, the employer should provide an equivalent respirator with a full facepiece, helmet, or hood.

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP.

NO. 304

METHYL ISOBUTYL KETONE
REVISION B

Date September 1979

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: METHYL ISOBUTYL KETONE
OTHER DESIGNATIONS: MIBK, "Hexone," 4-Methyl-2-pentanone, Methyl i-Butyl Ketone. Isobutyl Methyl Ketone, $CH_3COCH_2CH(CH_3)_2$, ASTM D1153, GE Material D5B73, CAS# 000 108 101

MANUFACTURER: Available from many suppliers.

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Methyl Isobutyl Ketone ($C_6H_{12}O$)	ca 100	8-hr TWA 100 ppm*(Skin) or 410 mg/m^3
		Human, inhalation TCLo 200 ppm (Irritation)
*Current OSHA Standard. ACGIH (1979 Intended Changes List) and NIOSH (1978) both recommend 50 ppm.		Rat, oral LD_{50} 2.08 g/kg

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C) ---	241 (116)	Specific gravity (H_2O=1) ---	0.80
Vapor pressure at 20 C, mm Hg -----	16	Volatiles, % ----------	ca 100
Vapor density (Air=1) ----------	3.5	Evaporation rate (BuAc=1) --	1.62
Solubility in H_2O at 20 C, wt.% ---	1.91	Melting point, deg F (C) ---	-119(-84)
		Molecular weight ----------	100.18

Appearance & Odor: Colorless, mobile liquid with a sharp, mint-like odor. Unfatigued, odor recognition threshold (100% test panel) is 0.3 to 0.5 ppm. Distinct odor at 15 ppm.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air % by Vol.	LOWER	UPPER
73 F (22.8 C) TCC	860 F (460 C)		1.4	7.5

Extinguishing Media: "Alcohol" foam, dry chemical, or CO_2. (Water may be ineffective.) A stream of water can scatter flames. Use a water spray to cool fire-exposed metal containers and to dilute or flush solvent.
A dangerous fire hazard and moderate explosion hazard when exposed to heat or flame. Vapors can flow along surfaces to distant ignition sources and flash back.
Self-contained breathing apparatus with eye protection is required for those fighting fires in enclosures in which this material is involved.

SECTION V. REACTIVITY DATA

This material is stable under normal storage and use conditions. It is a flammable liquid (OSHA Class IC)* and must be kept away from sparks, open flames, hot surfaces, and all sources of heat and ignition. Strong oxidizing agents can cause spontaneous ignition and violet reaction. Ignites on reaction with potassium t-butoxide.
Oxidation of MIBK in air can form carbon monoxide.
Solvent attacks some plastics, resins and rubbers.

*Measurement of flash point needed to classify as IB or IC for this borderline material.

Occupational Health Guideline for Tetrachloroethylene*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $CCl_2 = CCl_2$
- Synonyms: Perchloroethylene; perchlorethylene; tetrachlorethylene; perk
- Appearance and odor: Colorless liquid with an odor like chloroform or ether.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetrachloroethylene is 100 parts of tetrachloroethylene per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 200 ppm and a maximum acceptable peak of 300 ppm for 5 minutes in any three-hour period. NIOSH has recommended that the permissible exposure limit be reduced to 50 ppm (339 mg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 100 ppm (678 mg/m³) averaged over a 15-minute period. The NIOSH Criteria Document for Tetrachloroethylene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Tetrachloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

1. Short-term Exposure: Tetrachloroethylene may cause headache, nausea, drowsiness, dizziness, incoordination, and unconsciousness. It may also cause irritation of the eyes, nose, and throat and flushing of the face and neck. In addition, it might cause liver damage with such findings as yellow jaundice and dark urine. The liver damage may become evident several weeks after the exposure.

2. Long-term Exposure: Prolonged or repeated overexposure to liquid tetrachloroethylene may cause irritation of the skin. It might also cause damage to the liver and kidneys.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetrachloroethylene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to tetrachloroethylene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the liver and the cardiovascular and neurological systems should be stressed. The skin should be examined for evidence of chronic disorders.

—Liver function tests: Tetrachloroethylene may cause liver damage. A profile of liver function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis.

- **Summary of toxicology**

Tetrachloroethylene vapor is a narcotic. Rats did not survive when exposed for longer than 12-18 minutes to 12,000 ppm; when exposed repeatedly to 470 ppm they showed liver and kidney injury. Cardiac arrhythmias

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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attributed to sensitization of the myocardium to epinephrine have been observed with certain other chlorinated hydrocarbons, but exposure of dogs to concentrations of 5000 and 10,000 ppm tetrachloroethylene did not produce this phenomenon. Four human subjects were unable to tolerate 5000 ppm in a chamber for 6 minutes. They experienced vertigo, nausea, and mental confusion during the 10 minutes following cessation of exposure. In an industrial exposure to an average concentration of 275 ppm for 3 hours, followed by 1100 ppm for 30 minutes, a worker lost consciousness; there was apparent clinical recovery 1 hour after exposure but the monitored concentration of tetrachloroethylene in the patient's expired air diminished slowly over a 2-week period. Long-term industrial exposures have been reported to cause various neuropathies, such as numbness, trembling, neuritis, and defects of memory. During the second and third post-exposure weeks, the results of liver function tests became abnormal, suggesting that acute exposure had had a significant effect upon the liver. Other instances of liver injury following industrial exposure have been reported. Other effects on humans of inhalation of various concentrations are as follows: 2000 ppm, mild narcosis within 5 minutes; 600 ppm, sensation of numbness around the mouth, dizziness, and some incoordination after 10 minutes. In human experiments, 7-hour exposures at 100 ppm resulted in mild irritation of the eyes, nose, and throat; flushing of the face and neck; headache; somnolence; and slurred speech. Exposure of the skin to the liquid for 40 minutes resulted in a progressively severe burning sensation beginning within 5 to 10 minutes; the result was marked erythema, which subsided after 1 to 2 hours. The liquid sprayed into rabbits' eyes produced immediate pain and blepharospasm; patches of epithelium were lost, but the eyes recovered completely within 2 days.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 165.85
2. Boiling point (760 mm Hg): 121.2 C (250 F)
3. Specific gravity (water = 1): 1.62
4. Vapor density (air = 1 at boiling point of tetrachloroethylene): 5.83
5. Melting point: −22.4 C (−8 F)
6. Vapor pressure at 20 C (68 F): 14 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 015
8. Evaporation rate (butyl acetate = 1): 2.8

- **Reactivity**

1. Conditions contributing to instability: Heat.
2. Incompatibilities: Tetrachloroethylene reacts with rong oxidizers and chemically active metals such as rium, lithium, and beryllium.
3. Hazardous decomposition products: Toxic gases d vapors (such as hydrogen chloride, phosgene, and rbon monoxide) may be released when tetrachloroethylene decomposes.
4. Special precautions: Liquid tetrachloroethylene will attack some forms of plastics, rubber, and coatings.

- **Flammability**

1. Not combustible

- **Warning properties**

1. Odor Threshold: Both May and Stern state that 50 ppm is the odor threshold for tetrachloroethylene.
2. Eye Irritation Level: Grant reports that "exposure to high concentrations of (tetrachloroethylene) vapor causes mild sensation of irritation to the eyes, but serious injury is not likely." The exact concentrations producing irritation are not mentioned by Grant.

Spector, however, reports that after a 20- to 30-minute exposure to 206 to 235 ppm, eye irritation occurs in humans.

Patty reports "very slight irritation of the eyes" among humans at 106 ppm.

3. Other Information: Spector reports that a 10-minute exposure to 513 to 690 ppm produces nose and throat irritation.
4. Evaluation of Warning Properties: Since the odor threshold of tetrachloroethylene is below the permissible exposure limit, and since eye irritation occurs at a concentration only twice the permissible exposure limit, its warning properties are considered to be adequate.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of tetrachloroethylene. Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Peak Above Ceiling Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of tetrachloroethylene. Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of

three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tetrachloroethylene may be used. An analytical method for tetrachloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid tetrachloroethylene.

• Non-impervious clothing which becomes contaminated with liquid tetrachloroethylene should be removed promptly and not reworn until the tetrachloroethylene is removed from the clothing.

• Clothing wet with liquid tetrachloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetrachloroethylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the tetrachloroethylene, the person performing the operation should be informed of tetrachloroethylene's hazardous properties.

• Employees should be provided with and required to use splash-proof safety goggles where liquid tetrachloroethylene may contact the eyes.

SANITATION

• Skin that becomes contaminated with liquid tetrachloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any tetrachloroethylene.

• Employees who handle liquid tetrachloroethylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetrachloroethylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as dry cleaning solvent; as degreasing and metal cleaning agent; in vapor degreasing of metal parts	Local exhaust ventilation; general dilution; personal protective equipment
Use as chemical intermediate in production of fluorocarbons, pesticides, and trichloroacetic acid	Process enclosure; local exhaust ventilation; general dilution ventilation
Use as scouring, sizing, desizing, solvent and greaser remover in processing and finishing of textiles	Local exhaust ventilation; general dilution; personal protective equipment
Use as general industrial solvent in rubber, textile, printing, soap, and paint remover industries	Local exhaust ventilation; general dilution; personal protective equipment
Use as extraction agent for vegetable and mineral oils and in pharmaceutical industry; as vermifuge; as laundry treatment for presoaking and as drying medium in metal and wood industries	Local exhaust ventilation; general dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If tetrachloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If tetrachloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If tetrachloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of tetrachloroethylene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When tetrachloroethylene has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If tetrachloroethylene is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

• Waste disposal method:

Tetrachloroethylene may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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* SPECIAL NOTE

Tetrachloroethylene appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980). The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 20, 1979.

RESPIRATORY PROTECTION FOR TETRACHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s). A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Occupational Health Guideline for Toluene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_6H_5CH_3$
- Synonyms: Toluol; phenylmethane; methylbenzene
- Appearance and odor: Colorless liquid with an aromatic odor, like benzene.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for toluene is 200 parts of toluene per million parts of air (ppm) averaged over an eight-hour work shift, and during any such work shift, 300 ppm toluene may not be exceeded except that a peak of 500 ppm toluene is permitted for 10 minutes during the eight-hour work shift. NIOSH has recommended that the permissible exposure limit be reduced to 100 ppm toluene averaged over an eight-hour work shift with a ceiling level of 200 ppm averaged over a ten-minute period. The NIOSH Criteria Document for Toluene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Toluene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Toluene may cause irritation of the eyes, respiratory tract, and skin. It may also cause fatigue, weakness, confusion, headache, dizziness, and drowsiness. Peculiar skin sensation may be produced such as a "pins and needles feeling" or numbness. Very high concentrations may cause unconsciousness and death. The liquid splashed in the eye may cause irritation and temporary damage. Inhalation may also cause difficulty in seeing in bright light. If liquid toluene is splashed in the eyes, it will cause temporary irritation.

2. Long-term Exposure: Repeated or prolonged exposure to liquid toluene may cause drying and cracking of the skin.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to toluene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to toluene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the central nervous system, liver and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—Urinalysis: Since proper kidney function is necessary for biologic monitoring, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment. The urine should be analyzed for hippuric acid to obtain a background level.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on an annual basis. Hippuric acid level in urine may be an indicator of the level of toluene exposure.

- **Summary of toxicology**

Toluene vapor causes narcosis. Controlled exposure of human subjects to 200 ppm for 8 hours produced mild fatigue, weakness, confusion, lacrimation, and paresthesia; at 600 ppm for 8 hours there were also euphoria, headache, dizziness, dilated pupils and nausea; at 800

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ppm for 8 hours, symptoms were more pronounced, and after-effects included nervousness, muscular fatigue, and insomnia persisting for several days. Severe but reversible liver and kidney injury occurred in a person who was a glue-sniffer for 3 years; the chief component of the inhaled solvent was toluene (80% V/V); other ingredients were not listed. In workers exposed for many years to concentrations in the range of 80 to 300 ppm, there was no clinical or laboratory evidence of altered liver function. Toluene exposure does not result in the hematopoietic effects caused by benzene; the myelotoxic effects previously attributed to toluene are judged by more recent investigations to be the result of concurrent exposure to benzene present as a contaminant in the commercial toluene used. Most of the toluene absorbed from inhalation is metabolized to benzoic acid, conjugated with glycine in the liver to form hippuric acid, and excreted in the urine; the average amount of hippuric acid excreted in the urine by individuals not exposed to toluene is approximately 0.7 to 1.0 g/l of urine. The liquid splashed in the eyes of two workers caused transient corneal damage and conjunctival irritation; complete recovery occurred within 48 hours. Repeated or prolonged skin contact with liquid toluene has a defatting action, causing drying, fissuring, and dermatitis.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 92.1
  2. Boiling point (760 mm Hg): 111 C (231 F)
  3. Specific gravity (water = 1): 0.86
  4. Vapor density (air = 1 at boiling point of toluene): 3.14
  5. Melting point: −95 C (−139 F)
  6. Vapor pressure at 20 C (68 F): 22 mm Hg
  7. Solubility in water, g/100 g water at 20 C (68 F): 0.05
  8. Evaporation rate (butyl acetate = 1): 2.24
- **Reactivity**
  1. Conditions contributing to instability: Containers may burst at elevated temperatures.
  2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
  3. Hazardous decomposition products: Toxic gases and vapors (such as carbon dioxide and carbon monoxide) may be released in a fire involving toluene.
  4. Special precautions: Toluene will attack some forms of plastics, rubber, and coatings.
- **Flammability**
  1. Flash point: 4 C (40 F) (closed cup)
  2. Autoignition temperature: 480 C (896 F)
  3. Flammable limits in air, % by volume: Lower: 1.27; Upper: 7.1
  4. Extinguishant: Carbon dioxide, dry chemical, foam
- **Warning properties**
  1. Odor Threshold: The American National Standards Institute (ANSI) states that "the odor of toluene is detectable by most people at concentrations in the range of 10 to 15 ppm. The odor has little value as a warning property."

Patty points out that olfactory fatigue occurs rapidly upon exposure to toluene.

2. Eye Irritation Level: Grant states that "the vapors of toluene cause noticeable sensation of irritation to human eyes at 300 to 400 ppm in air, but even at 800 ppm irritation is slight."

ANSI reports that "irritation of eyes, mucous membranes, and upper respiratory tract may occur while workers are exposed to low concentrations of toluene. There is a considerable range of variation (100 to 500 ppm) between individuals, some finding any concentration of toluene objectionable. Commercial grades of toluene vary in irritant properties."

3. Evaluation of Warning Properties: Because of its irritant effects, toluene is judged to have good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of toluene. Each measurement should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Peak Above Ceiling Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of toluene. Each measurement should consist of a 10-minute sample or a series of consecutive samples totalling 10 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

- **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with a subsequent desorption of toluene with carbon disulfide and gas

chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure toluene may be used. An analytical method for toluene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

Methods for Set V" (order number PB 262 524).

RESPIRATORS

- Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.
- In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

- Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid toluene.
- Any clothing which becomes wet with liquid toluene should be removed immediately and not reworn until the toluene is removed from the clothing.
- Clothing wet with toluene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of toluene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the toluene, the person performing the operation should be informed of toluene's hazardous properties.
- Employees should be provided with and required to use splash-proof safety goggles where liquid toluene may contact the eyes.
- Where there is any possibility that employees' eyes may be exposed to toluene, an eye-wash fountain should be provided within the immediate work area for emergency use.

SANITATION

- Skin that becomes wet with liquid toluene should be promptly washed or showered with soap or mild detergent and water to remove any toluene.
- Employees who handle liquid toluene should wash their hands thoroughly with soap or mild detergent and water before eating or smoking.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to toluene may occur and control methods which may be effective in each case:

Operation	Controls
Use as a solvent in pharmaceutical, chemical, rubber, and plastics industries; as a thinner for paints, lacquer, coatings, and dyes; as a paint remover; insecticides	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as starting material and intermediate in organic chemical and chemical synthesis industries	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use in manufacture of artificial leather; fabric and paper coatings; photogravure ink production; spray surface coating; as a diluent (cellulose ester lacquers)	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment
Use as constituent in formulation of automotive and aviation fuels	Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If liquid toluene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If liquid toluene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and

water. If liquid toluene soaks through the clothing, remove the clothing immediately and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of toluene, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When toluene has been swallowed, get medical attention immediately. Do not attempt to make the exposed person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

• If toluene is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. For small quantities, absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for evaporating vapors to completely clear the hood ductwork. Burn the paper in a suitable location away from combustible materials. Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber. Toluene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of toluene vapors are permitted.

• Waste disposal method:

Toluene may be disposed of by atomizing in a suitable combustion chamber.

ADDITIONAL INFORMATION

To find additional information on toluene, look up toluene in the following documents:

• Medical Surveillance for Chemical Hazards
• Respiratory Protection for Chemical Hazards
• Personal Protection and Sanitation for Chemical Hazards
• NIOSH Criteria Document for Toluene (July 1973)

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

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• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• Union Carbide Corporation, Industrial Medicine and Toxicology Department: *Toxicology Studies – Toluene*, New York, 1970.

RESPIRATORY PROTECTION FOR TOLUENE

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with an organic vapor cartridge(s). Any supplied-air respirator. Any self-contained breathing apparatus.
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
2000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 2000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

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NO. 311
INHIBITED
1,1,1-TRICHLOROETHANE
REVISION D
DATE August 1983

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: INHIBITED 1,1,1-TRICHLOROETHANE
OTHER DESIGNATIONS: Methyl Chloroform, MC, CCl_3CH_3, GE Material D5B79, CAS# 000 071 556, α-Trichloroethane
TRADENAMES & MANUFACTURER: BLACO-THANE (Baron-Blakeslee), CHLOROTHENE NU & VG (Dow), INHIBISOL (Penetone Corp.), TRI-ETHANE (PPG Ind. Inc), TRITHENE (SRS, Inc.)

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
1,1,1-Trichloroethane	>95	8-hr TWA 350 ppm**
Inhibitor, typical*	< 5	Unknown
*Inhibitors used are proprietary. Commercial materials contain up to about 5% inhibitor and are designed for cold cleaning or vapor degreasing use or both.		Human, Inhalation LCLo 27 gm/m³/10 min
**Current OSHA PEL and ACGIH (1983) TLV. ACGIH STEL 450 ppm.		TCLo 920 ppm/70 min (CNS effects)
NIOSH (1976) proposed a 10-hr TWA of 200 ppm with a 350 ppm ceiling (15 minute sample) and has recommended caution in use		Human, Oral TDLo 670 mg/kg (GI effects)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F ----- ca 165*	Specific gravity, 25/25C --- 1.3-1.336*
Vapor pressure, 20 C, mm Hg ----- 100	Volatiles, % ---------- ca 100
Vapor density (Air=1) ---------- 4.55	Melting point, deg C ------- -32
Water solubility, g/100ml H_2O @20C - 0.09	Evaporation rate (CCl_4=1) -- 1
	Molecular weight ---------- 133.41

Appearance & Odor: Colorless liquid with a mild, sweetish, pleasant, ether-like odor which may be just perceptible (unfatigued) at about 100 ppm in air.
*Properties depend on the inhibitor and inhibitor level.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air (High energy ignition source at 25C), Vol. %	Lower	Upper
None	537 C (998 F)		8.0%	10.5%

This material is nearly nonflammable. High energy, such as electric arc, is needed for ignition, and the flame tends to go out when the ignition source is removed. Material involved in a fire can emit toxic and irritating fumes. Water fog, carbon dioxide, dry chemical, or foam may be used to fight fires.
Use self-contained or air-supplied breathing apparatus for protection against suffocating vapors and toxic and corrosive decomposition products.

SECTION V. REACTIVITY DATA

This material can be hydrolyzed by water to form hydrochloric acid and acetic acid. It will react with strong caustic, such as caustic soda or caustic potash to form flammable or explosive material. Attacks natural rubber.
It requires inhibitor content to prevent corrosion of metals; and when inhibitor is depleted, it can decompose rapidly by reaction with finely divided white metals, such as aluminum, magnesium, zinc, etc. Do not use these metals for storage containers or in pressurized spraying equipment where MC is involved.
It will decompose at high temperature upon contact with hot metal, or under ultra-violet radiation to produce toxic and corrosive gases (hydrogen chloride, dichloroacetylene, chlorine and some phosgene).

Occupational Health Guideline for 1,1,2-Trichloroethane*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $CHCl_2CH_2Cl$
- Synonyms: Vinyl trichloride; beta-trichloroethane
- Appearance and odor: Colorless liquid with a sweet odor, like chloroform.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,1,2-trichloroethane is 10 parts of 1,1,2-trichloroethane per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 45 milligrams of 1,1,2-trichloroethane per cubic meter of air (mg/m^3).

HEALTH HAZARD INFORMATION

- **Routes of exposure**

1,1,2-Trichloroethane can affect the body if it is inhaled if it comes in contact with the eyes or skin, or if it is swallowed. It may be absorbed through the skin.

- **Effects of overexposure**

1. Short-term Exposure: 1,1,2-Trichloroethane may cause irritation of the eyes and nose, drowsiness, incoordination, unconsciousness, and death. It might also cause liver and kidney damage.

2. Long-term Exposure: Repeated or prolonged exposure to 1,1,2-trichloroethane might cause liver or kidney damage.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,1,2-trichloroethane.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 1,1,2-trichloroethane at potentially hazardous levels:

1. Initial Medical Screening: Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,1,2-trichloroethane exposure.

—Liver disease: 1,1,2-Trichloroethane causes liver damage in animals and justifies consideration before exposing persons with impaired liver function.

—Kidney disease: 1,1,2-Trichloroethane causes kidney damage in animals and justifies special consideration in those with impaired renal function.

2. Periodic Medical Examination: Any employee developing the above-listed conditions should be referred for further medical examination.

- **Summary of toxicology**

1,1,2-Trichloroethane vapor is a potent narcotic. Injury to lungs, liver, and kidneys has been observed in animals. The lethal concentration for rats was 2000 ppm for 4 hours. Concentrations resulting in narcosis also caused irritation of the nose and eyes. Mice treated by intraperitoneal injection with anesthetic doses showed moderate hepatic dysfunction and renal dysfunction; at autopsy, there was centrolobular necrosis of the liver and tubular necrosis of the kidney. No human cases of intoxication or systemic effects from industrial exposure have been reported.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1. Molecular weight: 133.4
2. Boiling point (760 mm Hg): 113 C (236 F)
3. Specific gravity (water = 1): 1.43
4. Vapor density (air = 1 at boiling point of 1,1,2-trichloroethane): 4.55
5. Melting point: −37 C (−34 F)
6. Vapor pressure at 20 C (68 F): 18.8 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F):

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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0.45

8. Evaporation rate (butyl acetate = 1): Data not available

• Reactivity

1. Conditions contributing to instability: Heat.

2. Incompatibilities: Contact with strong oxidizers, strong caustics, and chemically active metals such as aluminum and magnesium powders, sodium or potassium may cause fires and explosions.

3. Hazardous decomposition products: Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving 1,1,2-trichloroethane.

4. Special precautions: Liquid 1,1,2-trichloroethane will attack some forms of plastics, rubber, and coatings.

• Flammability

1. Flash point: None in normal test method

2. Autoignition temperature: Data not available

3. Flammable limits in air, % by volume: Lower: 6.0; Upper: 15.5 (high energy ignition source required)

4. Extinguishant: Foam, carbon dioxide, dry chemical

• Warning properties

1. Odor Threshold: Although 1,1,2-trichloroethane is known to have a sweet, chloroform-like odor, no quantitative data are available concerning the odor threshold of this substance.

2. Eye Irritation Level: Grant reports that high concentrations of the vapors are irritating to the eyes. The concentrations at which this irritation occurs are not stated.

3. Other Information: Grant reports that high concentrations of the vapors are irritating to the respiratory tract, but no quantitative information is given.

4. Evaluation of Warning Properties: Since no quantitative information is available relating the warning properties to air concentrations of 1,1,2-trichloroethane, this substance has been treated as a material with poor warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 1,1,2-trichloroethane may be used. An analytical method for 1,1,2-trichloroethane is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 5, 1979, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00349-1).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 1,1,2-trichloroethane.

• Clothing wet with liquid 1,1,2-trichloroethane should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,1,2-trichloroethane from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the 1,1,2-trichloroethane, the person performing the operation should be informed of 1,1,2-trichloroethane's hazardous properties.

• Non-impervious clothing which becomes contaminated with liquid 1,1,2-trichloroethane should be removed promptly and not reworn until the 1,1,2-trichloroethane is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid 1,1,2-trichloroethane may contact the eyes.

SANITATION

• Skin that becomes contaminated with liquid 1,1,2-trichloroethane should be promptly washed or showered with soap or mild detergent and water to remove any 1,1,2-trichloroethane.

• Eating and smoking should not be permitted in areas where liquid 1,1,2-trichloroethane is handled, processed, or stored.
• Employees who handle liquid 1,1,2-trichloroethane should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,1,2-trichloroethane may occur and control methods which may be effective in each case:

Operation	Controls
Use in organic synthesis in production of vinylidene chloride	General dilution ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.
• **Eye Exposure**
If 1,1,2-trichloroethane gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.
• **Skin Exposure**
If 1,1,2-trichloroethane gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water. If 1,1,2-trichloroethane soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.
• **Breathing**
If a person breathes in large amounts of 1,1,2-trichloroethane, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.
• **Swallowing**
When 1,1,2-trichloroethane has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.
• **Rescue**
Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.
• If 1,1,2-trichloroethane is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Collect for reclamation or absorb in vermiculite, dry sand, or a similar material.
• Waste disposal method:
1,1,2-Trichloroethane may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill.

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• Union Carbide Corporation, Industrial Medicine and Toxicology Department: *Toxicology Studies - 1,1,2-Trichloroethane*, New York, 1972.

* SPECIAL NOTE

1,1,2-Trichloroethane appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol. 45, No. 157, pp. 5372-5379, 12 August 1980).
The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer. See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*. Volume 20, 1979.

RESPIRATORY PROTECTION FOR 1,1,2-TRICHLOROETHANE

Condition	Minimum Respiratory Protection* Required Above 10 ppm
Vapor Concentration	
500 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

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NO. 312

TRICHLOROETHYLENE

Revision D

Date July 1979

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: TRICHLOROETHYLENE
OTHER DESIGNATIONS: TCE, Trichloroethylene, Ethylene Trichloride, Ethenyl Trichloride, $CHCl{=}CCl_2$, GE Material D5B56, CAS# 000 079 016
MANUFACTURER & TRADE NAMES: BLACO-TRI (Baron-Blakeslee); ALK-TRI, HI-TRI and NEU-TRI (Dow); KAYNIDE (Kraft); PERM-A-CLOR and TRIAD (Detrex); TRICHLOR (PPG); TRICLENE D & MD (Diamond Shamrock)

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Trichloroethylene + Stabilizer* *Stabilizers such as amines or epoxy compounds are usually added at low levels to increase resistance to oxidation and to polymerization. Vapor degreasing grades require higher stabilizer levels. **ACGIH (1979 Intended Changes List) proposes an 8-hr TWA of 50 ppm with STEL 150 ppm. NIOSH (1978) reviewed TCE as a suspected carcinogen and suggested a TWA of 25 ppm as readily attainable. Unresolved controversy on TCE carcinogenicity at present.	ca 100	TLV 100 ppm with 200 ppm Ceiling level** Human, Oral LDLo 857 mg/kg Human, Inhal. TCLo 160 ppm/83 min (central nervous system)

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg F (C)	188 (87)	Specific gravity 20 C	1.45-1.47*
Vapor pressure @ 20°C, mm Hg	58	Volatiles %	ca 100
Vapor density (Air = 1)	4.54	Evaporation rate (CCl_4=1)	0.69
Water solubility @ 25°C, %	0.1	Freezing point, deg C	-73 to -86*
		Molecular weight	131.39

Appearance & Odor: Colorless, mobile liquid with a characteristic, sweet, ether-like odor whose recognition threshold is 21.4 ppm in air (unfatigued, 100% of test panel).
*Depends on stabilizer and level used.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits		LOWER	UPPER
None	770 F (410 C)	in air, Vol %	@ 57C	15	40
			@100C	2.5	90%

Extinguishing Media: Use that which is appropriate for surrounding fire. Trichloroethylene is normally considered noncombustible. However, when 15% vapor in air at 33 C is exposed to intense heat (electric arc) or to ordinary flame at vapor-air temperatures exceeding 50 C, it can be made to burn mildly. Combustibility increases in O_2-enriched air.
Self-contained breathing apparatus should be used for protection against TCE vapors and their toxic and corrosive decomposition products in a fire situation.

SECTION V. REACTIVITY DATA

TCE is considered to be a stable compound under normal conditions of storage and handling. However, when it is heated (as in a vapor degreaser) or exposed to sunlight, it requires stabilization against oxidation, degradation and polymerization. When it is exposed to high temperatures, hydrogen chloride and phosgene (highly toxic) can be produced as decomposition products. It is slowly decomposed by light when moist.
TCE can react with NaOH, KOH, or other strong alkali to form explosive mixtures of chloroacetylenes. Soda ash does not react.
Polymerization of TCE is catalyzed by aluminum chloride. Magnesium or aluminum powder can react with TCE.

Occupational Health Guideline for Xylene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $C_6H_4(CH_3)_2$
- Synonyms: Commercial xylene (xylol) is a mixture, mostly the meta-isomer. 1) O-xylene, ortho-xylene, 1,2-dimethylbenzene; 2) m-xylene, meta-xylene, 1,3-dimethylbenzene; 3) p-xylene, para-xylene, 1,4-dimethylbenzene
- Appearance and odor: Colorless liquids with aromatic odors (pure p-xylene is a solid below 12.7 C (55 F)).

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for xylene is 100 parts of xylene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 435 milligrams of xylene per cubic meter of air (mg/m^3). NIOSH has recommended that the permissible exposure limit be changed to 100 ppm averaged over a work shift of up to ten hours per day, forty hours per week, with an acceptable ceiling level of 200 ppm averaged over a 10-minute period. The NIOSH Criteria Document for Xylene should be consulted for more detailed information.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Xylene can affect the body if it is inhaled, if it comes in contact with the eyes or skin, or if it is swallowed. It may enter the body through the skin.

- **Effects of overexposure**

1. Short-term Exposure: Xylene vapor may cause irritation of the eyes, nose, and throat. At high concentrations, xylene vapor may cause severe breathing difficulties which may be delayed in onset. At high concentrations, it may also cause dizziness, staggering, drowsiness, and unconsciousness. In addition, breathing high concentrations may cause loss of appetite, nausea, vomiting, and abdominal pain. Liquid xylene may be irritating to the eyes and skin. Exposure to high concentrations of xylene vapor may cause reversible damage to the kidneys and liver.

2. Long-term Exposure: Repeated or prolonged exposure to xylene may cause a skin rash. Repeated exposure of the eyes to high concentrations of xylene vapor may cause reversible eye damage.

3. Reporting Signs and Symptoms: A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to xylene.

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to xylene at potentially hazardous levels:

1. Initial Medical Examination:

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the central nervous system, eyes, gastrointestinal tract, blood, liver, and kidneys should be stressed. The skin should be examined for evidence of chronic disorders.

—A complete blood count: Xylene has been shown to cause reversible hematopoietic depression in animals. A complete blood count should be performed, including a red cell count, a white cell count, a differential count of a stained smear, as well as hemoglobin and hematocrit.

—Liver function tests: Since liver damage has been observed in humans exposed to xylene, a profile of liver

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

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function should be obtained by using a medically acceptable array of biochemical tests.

—Urinalysis: Since kidney damage has been observed in humans exposed to xylene, a urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment.

2. Periodic Medical Examination: The aforementioned medical examinations should be repeated on a biannual basis.

• **Summary of toxicology**

Xylene vapor irritates the eyes, mucous membranes, and skin; at high concentrations it causes narcosis. In animals, xylene causes blood changes reflecting mild toxicity to the hematopoietic system. Repeated exposure of rabbits to 1150 ppm of a mixture of isomers of xylene for 40 to 55 days caused a reversible decrease in red and white cell count and an increase in thrombocytes; exposure to 690 ppm for the same time period caused only a slight decrease in the white cell count. Three painters working in a confined space of a fuel tank were overcome by xylene vapors estimated to be 10,000 ppm; they were not found until 18.5 hours after entering the tank, and one died from pulmonary edema shortly thereafter; the other two recovered completely in 2 days; both had temporary hepatic impairment (inferred from elevated serum transaminase levels) and one of them had evidence of temporary renal impairment (increased blood urea and reduced creatinine clearance). In humans, exposure to undetermined but high concentrations caused dizziness, excitement, drowsiness, incoordination and a staggering gait. Workers exposed to concentrations above 200 ppm complain of anorexia, nausea, vomiting, and abdominal pain. Brief exposure of humans to 200 ppm caused irritation of the eyes, nose, and throat. There are reports of reversible corneal vacuolation in workers exposed to xylene, or to xylene plus other volatile solvents. The liquid is a skin irritant and causes erythema, dryness, and defatting; prolonged contact may cause the formation of vesicles.

CHEMICAL AND PHYSICAL PROPERTIES

Data in the following section are presented for xylene's three isomers: 1) ortho, 2) meta, and 3) para.

• **Physical data**

1. Molecular weight: 106.2
2. Boiling point (760 mm Hg): 1) 144.4 C (292 F); 2) 138.9 C (282 F); 3) 138.3 C (281 F)
3. Specific gravity (water = 1): 1) 0.88; 2) 0.86; 3) 0.86
4. Vapor density (air = 1 at boiling point of xylene): 3.7
5. Melting point: 1) −25 C (−12 F); 2) −48 C (−54 F); 3) 13 C (55 F)
6. Vapor pressure at 20 C (68 F): 1) 7 mm Hg; 2) 9 mm Hg; 3) 9 mm Hg
7. Solubility in water, g/100 g water at 20 C (68 F): 1) 0.00003; 2) 0.00003; 3) 0.00003
8. Evaporation rate (butyl acetate = 1): 1) 0.7; 2) 0.7; 3) 0.7

• **Reactivity**

1. Conditions contributing to instability: Elevated temperatures may cause containers to burst.
2. Incompatibilities: Contact with strong oxidizers may cause fires and explosions.
3. Hazardous decomposition products: Toxic gases and vapors (such as carbon monoxide) may be released in a fire involving xylene.
4. Special precautions: Xylene will attack some forms of plastics, rubber, and coatings.

• **Flammability**

1. Flash point: 1) 32 C (90 F) (closed cup); 2) 28.9 C (84 F); 3) 27.2 C (81 F)
2. Autoignition temperature: 1) 465 C (869 F); 2) 530 C (986 F); 3) 530 C (986 F)
3. Flammable limits in air, % by volume: Lower: 1) 1.0; 2) 1.1; 3) 1.1; Upper: 1) 6.0; 2) 7.0; 3) 7.0
4. Extinguishant: Foam, carbon dioxide, dry chemical

• **Warning properties**

1. Odor Threshold: Patty states that "the initial odor of 200 ppm has an intensity of approximately 3 and an irritation value of 1. As in most other instances, olfactory fatigue occurs rapidly and the odor is no longer detected at this concentration."
2. Eye Irritation Level: The AIHA *Hygienic Guide* states that "exposure to vapors at 200 ppm caused eye irritation in most of the persons tested. Lesions in the form of fine vacuoles in the cornea of cats exposed to commercial xylene vapors have been observed."
3. Other Information: The *Handbook of Industrial Organic Chemicals* states that xylene "may be irritating to eyes, nose and throat as exposure exceeds threshold limit." The *Hygienic Guide* notes that 200 ppm causes irritation of the nose and throat.
4. Evaluation of Warning Properties: Through its irritant effects, xylene can be detected within three times the permissible exposure limit. For the purposes of this guideline, therefore, xylene is treated as a material with good warning properties.

MONITORING AND MEASUREMENT PROCEDURES

• **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of xylene. Each measurement

should consist of a ten (10) minute sample or series of consecutive samples totalling ten (10) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.

• **Method**

Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis. Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure xylene may be used. An analytical method for xylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid or solid xylene.

• Clothing contaminated with xylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of xylene from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the xylene, the person performing the operation should be informed of xylene's hazardous properties.

• Any clothing which becomes wet with liquid xylene should be removed immediately and non-impervious clothing which becomes contaminated with xylene should be removed promptly and not reworn until the xylene is removed from the clothing.

• Employees should be provided with and required to use splash-proof safety goggles where liquid or solid xylene may contact the eyes.

SANITATION

• Skin that becomes contaminated with xylene should be promptly washed or showered with soap or mild detergent and water to remove any xylene.

• Employees who handle liquid or solid xylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to xylene may occur and control methods which may be effective in each case:

Operation	Controls
Use as an intermediate during manufacture of plastics, synthetic fibers, and mixed/pure isomers	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment
Use as diluent or solvent in surface coatings, printing operations, and manufacture of rubber; degreasing agent in plastics and electronics manufacture; in organic synthesis reactions and manufacture of epoxy resins	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment
Use in formulation of insecticides	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment
Use in manufacture of xylene-formaldehyde resins; pharmaceuticals, vitamins, leather; and as a sterilizing agent for cat-gut and in microscopy	Process enclosure; local exhaust ventilation; general mechanical ventilation; personal protective equipment

RESPIRATORY PROTECTION FOR XYLENE (XYLOL)

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s).
5000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
10,000 ppm or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 10,000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

Operation	Controls
Use as an extraction solvent for edible fats, coca, butter, beer flavoring in hops, decaffeinated coffee, oleoresin manufacture, oils, waxes, perfumes, flavorings, and drugs	General dilution ventilation; local exhaust ventilation; personal protective equipment
Use as a solvent for paints, lacquers, varnishes, enamels, adhesives, rubber cements, manufacture of printed circuit boards, as a carrier for pharmaceutical tablet coatings, shrink-fitting of synthetic rubber covers, and dyeing of synthetic fibers	General dilution ventilation; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

- **Eye Exposure**

If methylene chloride gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention. Contact lenses should not be worn when working with this chemical.

- **Skin Exposure**

If methylene chloride gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water if the methylene chloride has not already evaporated. If methylene chloride soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water. If irritation persists after washing, get medical attention.

- **Breathing**

If a person breathes in large amounts of methylene chloride, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

- **Swallowing**

When methylene chloride has been swallowed, get medical attention immediately. If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace. Do not make an unconscious person vomit.

- **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.
- If methylene chloride is spilled or leaked, the following steps should be taken:

1. Remove all ignition sources.
2. Ventilate area of spill or leak.
3. Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material.

REFERENCES

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RESPIRATORY PROTECTION FOR METHYLENE CHLORIDE

Condition	Minimum Respiratory Protection* Required Above 500 ppm
Vapor Concentration	
5000 ppm or less	Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
Greater than 5000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	Any gas mask providing protection against organic vapors. Any escape self-contained breathing apparatus.

*Only NIOSH-approved or MSHA-approved equipment should be used.

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9410.1D

DATE January 13, 1987

SUPERSEDES 9410.1C (7/7/86)

APPROVED David R. Smith
David R. Smith

SUBJECT:

PREEMPLOYMENT MEDICAL EXAMINATIONS

I. PURPOSE

To provide appropriate preemployment physical examinations to job candidates.

II. ATTACHMENTS

A. Notification and Authorization Form

B. Authorization for Treatment

C. Medical Surveillance Program Brochure

D. Medical Examination Report

E. Physical Activity Restriction

F. Notice

III. PROCEDURE

A. The Regional Manager of Health & Safety will determine which new hire applicants shall be provided a preemployment physical examination. Drug & alcohol screening tests will be conducted for all new hire candidates (reference ITC PRO 9410.6). Results of all tests shall be available prior to an offer of employment.

1. Temporary job applicants and contractor's employees, who will be assigned to jobs with potential workplace chemical and physical hazards, shall also receive the physical exam and drug and alcohol test prior to employment.

2. Temporary job applicants and contractor's employees, who have not been assigned to jobs with potential workplace chemical or physical hazards, shall be administered the physical exam and drug and alcohol test when their status changes to regular full-time or part-time employment with potential workplace chemical and physical hazards within International Technology Corporation.

B. Applicants will be asked to sign the attached Notification (Attachment A) when they complete the ITC Employment Application, or

INTERNATIONAL TECHNOLOGY CORPORATION

NOTIFICATION

PHYSICAL EXAMINATIONS

International Technology Corporation (IT) provides a comprehensive range of environmental services dedicated to the assessment, mitigation and decontamination of situations involving hazardous and toxic substances. In employing you to assist in performing these services, IT will make every effort to inform you of the potential for and protect you from the consequences of harmful exposures to any of those substances.

The preemployment physical examination and update/periodic exam you receive are part of this informative and protective process but neither should be interpreted as complete physical examinations. These are screening tests to determine your physical and emotional fitness to perform job assignments without undue hazard to yourself or fellow employees.

You should still have regular physical examinations by your own physician as these examinations are not substitutes for them. We will be glad to provide your doctor with information on any work we do. Please indicate by placing your signature and the date in the spaces provided below that you understand the nature of IT's services, and role of preemployment physicals and update/periodic examinations, and your responsibility to have regular physical examinations.

Signature_____ Date _____

INFORMED CONSENT STATEMENT ON ALCOHOL AND DRUG ABUSE

I understand that as part of the preemployment evaluation process and the update/periodic medical surveillance program with International Technology Corporation, I will be required to provide a body fluid specimen to be analyzed for the presence of a variety of "street drugs". I understand that the presence of any drugs not prescribed by a licensed professional could be cause for rejection of my employment application or termination of my employment.

Due to the sensitive nature of the work done here, the high incidence of substance abuse in our population, and the need to maintain a high level of health and safety, I agree to submit to a urine screening test for psychoactive chemical agents including "street drugs" and alcohol.

I have read the above and understand the contents. I further understand that this authorization will remain in effect until my employment is terminated.

_____ _____

Candidate/Employee Name (printed) Date

_____

Candidate/Employee Signature

INTERNATIONAL TECHNOLOGY CORPORATION

Check Appropriate Block
☐ Industrial Injury
☐ Medical Screening

LOCATION _____ IT DIVISION _____ PC NO. _____ PROJECT NO. _____

AUTHORIZATION FOR TREATMENT/EXAMINATION

☐ Work Related Injury/Illness
☐ Drug Screen Only
☐ Preplacement Examination
☐ Update/Periodic Examination
☐ End-of-project Examination
☐ Exit Examination
☐ Other _____

Date of Injury/Exam _____
Employee's Name _____
Job Title _____
Employee's S.S.# _____
Supervisor's name _____
Site Location _____

Dr. _____ Address _____

Phone No. _____

Industrial Injury

In the case of work-related accidents, please examine the above-named employee and if injury or illness is industrial, render necessary conservative treatment. Please forward copies of:

1. Completed Doctor's First Report of Work Injury,
2. This form when fully completed,
3. All subsequent reports, including progress at monthly intervals, and
4. Billing.

to the following address (over)

Medical Screening

In the case of preplacement, update/periodic, end-of-project, exit, or other exams, forward to Daniel F. Rubin, M.D., Health, Safety & Training, International Technology Corporation, PO Box 2995, Torrance, CA 90509, the following:

1. This form,
2. All examination data, results, Doctor's statements, etc., and
3. Billing.

IT Authorization Signature _____ Date _____ Phone No. _____

Doctor, please provide:

A. Medical Diagnosis _____

B. Treatment Rendered or Recommended _____

C. Recommended Work Limitation/Restriction _____

D. Return Appointment Recommended ☐ Yes ☐ No When _____

E. First-Aid Only This Visit ☐ Yes ☐ No _____ M.D.
(PRINTED)

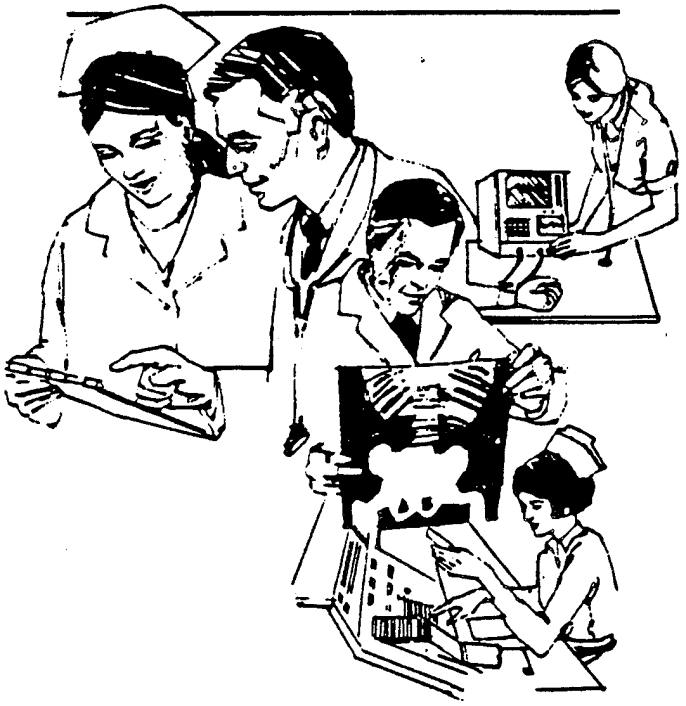
F. Time In _____ Out _____ _____
SIGNATURE

ITC Form 9462-3 (2/86)

74-9-85

INTERNATIONAL TECHNOLOGY CORPORATION

MEDICAL SURVEILLANCE PROGRAM



EMPLOYEE NAME

DATE

Physical Activity Restriction

EMPLOYEE'S NAME _____ DATE _____

DIVISION _____ LOCATION _____

DATE OF INJURY/EXAM _____ JOB TITLE _____

Employee is subject to the following physical activity restriction(s):

_____

_____

_____

_____

_____

_____

_____

☐ Acceptable for work under restriction stated above

☐ Not acceptable for work under restriction stated above

By _____

Date _____

_____
Employee Date

_____
Manager Date

_____
Health & Safety Date

Distribution: Health & Safety
Administration Manager

ITC Form 9410-1
(Rev. 1/85)

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9410.2B

DATE July 7, 1986

SUPERSEDES 9410.2A (8/27/84)

APPROVED David R. Smith

SUBJECT:

PERIODIC/UPDATE PHYSICAL EXAMINATIONS

I. PURPOSE

To provide appropriate periodic/update physical examinations to employees who have received the IT preemployment or baseline physical examinations.

II. ATTACHMENTS

A. IT Authorization for Treatment

B. Periodic/Update Questionnaire

C. Medical Examination Report

D. Physical Activity Restriction

III. PROCEDURE

A. The IT Health & Safety Division will determine the need for, and interval of, an update/periodic physical examination. This is based on the employee's job position and the results of his/her previous examination.

B. Health & Safety personnel will notify the appropriate profit center when an employee is due for a physical exam.

C. The appointment with the physician will be arranged by Health & Safety or Human Resources personnel.

D. The individual will be provided an IT "Authorization for Treatment" (Attachment A).

E. The medical questionnaire (Attachment B) and any related paperwork shall be completed by employee prior to his/her visit to the physician.

F. Following review of the physical examination results by the IT Medical Consultant, the employee's profit center manager will be notified by way of the IT "Medical Examination Report" (Attachment C) of the outcome of the current physical exam, including any Physical Activity Restriction (Attachment D).

Medical Examination Report

_____
Date

To: _____

IT Division: _____

Location: _____

_____ has received the appropriate:

- ☐ Preemployment examination
- ☐ Periodic examination
- ☐ DOT/DMV examination
- ☐ Other _____

and has been found to be:

- ☐ Acceptable; no restriction.
- ☐ Acceptable; subject to the attached "Physical Activity Restriction"*
- ☐ Not acceptable.

_____
Occupational Safety & Health Department

* For "Physical Activity Restriction":
1. Have employee read and sign restriction
2. Provide manager signature
3. Return form intact to the Occupational Safety & Health Department

ITC FORM 9410-1A (11/84)

INTERNATIONAL TECHNOLOGY CORPORATION

IT LOCATION _____
IT DIVISION _____
PC NO. _____
PROJECT NO. _____

UPDATE/END-OF-PROJECT/TERMINATION EXAMINATION

NAME _____ JOB TITLE _____ SEX _____ AGE _____
ADDRESS _____ CITY _____ STATE _____ ZIP _____
BIRTH DATE _____ SS NO. _____ PHONE NO. ( ) _____

It is important to bring to the attention of the doctor any changes in your health status occurring since your last health examination. Therefore, please carefully answer the following questions. Explain all items checked yes below.

		YES	NO
1.	Have you had any injury or illness other than colds?		
2.	Have you been hospitalized for any reason?		
3.	Have you had any surgery in or out of the hospital?		
4.	Have you had any abnormal x-rays or electrocardiograms: any abnormal blood, urine, or laboratory tests?		
5.	Have you been nervous, depressed, or tense or had any emotional trouble?		
6.	Have you had headaches, dizzy spells or black-outs?		
7.	Have you had trouble with your eyes — change in vision, blurring, seeing double, pain or glaucoma?		
8.	Have you had trouble with nose and throat — persistent hoarsness, voice change?		
9.	Have you had trouble with ears — pain, change in hearing, noise exposure?		
10.	Have you had chronic cough; any sputum that was bloody, excessive or colored; any pain on breathing?		
11.	Have you had shortness of breath, difficulty breathing, any swelling of the ankles?		
12.	Have you had any chest pain, or history of heart trouble or high blood pressure?		
13.	Have you had abdominal pain (or distress) or persistent vomiting?		
14.	Have you had any change in bowel habits; any bloody or tarry black stools?		
15.	Have you had trouble starting, stopping, or holding urine, any bloody or very dark urine; any discharge?		
16.	Are you now taking any medication?		
17.	Have you had skin rashes, sores, new or growing lumps, or changing moles?		
18.	Have you gained or lost 10 pounds or more?		
19.	Have you had any pain, swelling or stiffness of back or joints?		
20.	Have you been bleeding or bruising more than at time of last examination?		
21.	Has there been any change in the family medical history, such as appearance of diabetes, heart disease, strokes, blood problems or conditions that you think may be inherited?		
22.	Are you a Diabetic?		
23.	Are you pregnant?		
24.	Have you had a Tetanus Immunization within the last 10 years?		

25. If you still smoke, how much? _____ How many years have you smoked? _____
26. Present use of alcohol: social _____ moderate _____ heavy _____
27. For employee or spouse(s), number of pregnancies _____ number of miscarriages _____
28. If you have any medical problems you wish to discuss, please write them in.

Explain items checked yes

_____

_____

_____

_____

I hereby certify that to the best of my knowledge the foregoing answers are complete and correct and I understand that any false statement or incorrect ormation may result in my termination. I agree that this form and any information acquired as a result of this examination will become the property of the employer. I hereby grant permission to obtain records from all physician(s) or hospital(s) where I have been or am receiving medical treatment.

SIGNATURE _____ DATE _____

ITC FORM 9410.2 (2/86)

Physical Activity Restriction

EMPLOYEE'S NAME _____ DATE _____

DIVISION _____ LOCATION _____

DATE OF INJURY/EXAM _____ JOB TITLE _____

Employee is subject to the following physical activity restriction(s):

_____

_____

_____

_____

_____

_____

_____

☐ Acceptable for work under restriction stated above

☐ Not acceptable for work under restriction stated above

By _____

Date _____

_____
Employee Date

_____
Manager Date

_____
Health & Safety Date

Distribution: Health & Safety
Administration Manager

ITC Form 9410-1
(Rev. 1/85)

INTERNATIONAL TECHNOLOGY CORPORATION

Check Appropriate Block
☐ Industrial Injury
☐ Medical Screening

LOCATION _____ IT DIVISION _____ PC NO. _____ PROJECT NO. _____

AUTHORIZATION FOR TREATMENT/EXAMINATION

☐ Work Related Injury/Illness
☐ Drug Screen Only
☐ Preplacement Examination
☐ Update/Periodic Examination
☐ End-of-project Examination
☐ Exit Examination
☐ Other _____

Date of Injury/Exam _____
Employee's Name _____
Job Title _____
Employee's S.S.# _____
Supervisor's name _____
Site Location _____
_____

Dr. _____ Address _____

Phone No. _____ _____

Industrial Injury

In the case of work-related accidents, please examine the above-named employee and if injury or illness is industrial, render necessary conservative treatment. Please forward copies of:

1. Completed Doctor's First Report of Work Injury,
2. This form when fully completed,
3. All subsequent reports, including progress at monthly intervals, and
4. Billing.

to the following address (over)

Medical Screening

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1. This form,
2. All examination data, results, Doctor's statements, etc., and
3. Billing.

IT Authorization Signature _____ Date _____ Phone No. _____

Doctor, please provide:

A. Medical Diagnosis _____

_____

B. Treatment Rendered or Recommended _____

_____

C. Recommended Work Limitation/Restriction _____

_____

D. Return Appointment Recommended ☐ Yes ☐ No When _____

E. First-Aid Only This Visit ☐ Yes ☐ No _____ M.D.
(PRINTED)

F. Time In _____ Out _____ _____
SIGNATURE

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9540.1C

PAGE 1 OF 3

EFFECTIVE DATE June 29, 1981

SUPERSEDES July 14, 1980

APPROVED David R. Smith
David R. Smith

SUBJECT:

TAILGATE SAFETY MEETINGS

I. PURPOSE: To explain the concept and value of Tailgate Safety Meetings as a training tool, and provide guidelines on the proper use of ITC Form 9540-1C.

II. REFERENCE: Title 8, California Administrative Code 3203

III. ATTACHMENT: Completed sample of Form 9540-1C

IV. OFFICE OF PRIMARY RESPONSIBILITY:

Corporate Director, Occupational Safety and Health

V. DISCUSSION:

Tailgate Safety Meetings are required in order to fulfill regulatory provisions for employee training and indoctrination on workplace hazards (reference) and as a means to minimize workplace incurred injuries and illnesses.

VI. ACTION:

Meetings are to be conducted by the supervisor, safety representative, or other qualified person. Meetings shall be conducted at the beginning of each shift for each job or whenever new employees arrive at the job site. These meetings are to be documented in writing by the use of ITC Form 9540-1C.

It is important that the form be fully completed. The Tailgate Safety Meeting documentation must be identifiable with the specific job, location, and personnel.

All regions shall assure that the Tailgate Safety Meeting form is properly completed, submitted to the Operations Manager for review and signature, and a copy forwarded to the Occupational Safety & Health Department in accordance with the following guidelines:

A. Division/Subsidiary - specific profit center

B. Facility - specific profit center location

TAILGATE SAFETY MEETING

Division/Subsidiary: IT Services Facility: Wilmington

Date: 04/01/81 Time: 0730 Job Number: 0001

Customer: Cal Petrochem, Inc. Address: 123 Main St., Anywhere, USA

Specific Location: Tank Farm, Section C, Number 121

Type of Work: Remove sludge, clean, gas-free a leaded gasoline tank

Chemicals Used: Rochem CW

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment: White tyvek, light PVC suits, PVC boots and gloves, P/D airline respirators, lifelines and harnesses, earplugs

Chemical Hazards: Adverse properties of gasoline, tetraethyl lead and Rochem CW; no hazardous reactions expected.

Physical Hazards: Slippery surfaces when wet, locations of interior lines and sumps.

Emergency Procedures: Rescue procedures/first aid/medical care; spill control measures.

Hospital / Clinic: Anywhere Community Hosp Phone: (000) 555-1212 Paramedic Phone: (000) 555-2000

Hospital Address: 789 Main Street, Anywhere, USA

Special Equipment: Proper techniques and hand signals for Pitman crane

Other: Duties of standby man.

ATTENDEES

NAME PRINTED	SIGNATURE
John Doe	
Jane Doe	
Bob Brown (IT Transportation)	
Ira Inspector	

Meeting conducted by: Fred Foreman (NAME PRINTED) (SIGNATURE)

SUPERVISOR: A. Super Visor MANAGER:

ITC Form 9540-1C (revised 7/81)

IT CORPORATION

STANDARD PROCEDURE

PROCEDURE NO. ITC PRO 9552A

DATE May 20, 1986

SUPERSEDES 9552 (03/05/82)

APPROVED D R Smith

David R. Smith

SUBJECT:

Hazard Communication Program

I. PURPOSE

To provide a hazard communication program in compliance with Federal and State regulations which provides for: evaluation of hazardous substances, information and training for employees on hazardous substances, container labeling and other forms of warning, and material safety data sheets (MSDS).

The above requirements apply to hazardous materials in the workplace.

Although hazardous waste substances are excluded from the State and Federal standards for MSDS and labeling purposes, every effort shall be made to inform and train all employees on hazards and protection requirements when exposed to or handling hazardous wastes.

Regional Health and Safety Managers will be cognizant of any local and state right-to-know regulations at their locations and provide compliance guidelines to IT facilities in those areas. Examples include right-to-know regulations in Pennsylvania and New Jersey.

II. REFERENCES

A. Title 8, California Administrative Code, Sections 3203, 3204 and 5194
B. Title 29, Code of Federal Regulations, Part 1910.1200
C. ITC PRO 9540.1, Tailgate Safety Meetings
D. ITC PRO 9420.1, Access To Employment Exposure and Medical Records

III. ATTACHMENTS

A. Appendix A, Hazardous Materials Identification System (HMIS)
B. OSHA Form 174, U.S. Department of Labor Material Safety Data Sheet, September, 1985
C. ITC FORM 9552-1A, Material Safety Data Sheet
D. ITC FORM 9552-2A, Material Safety Data Sheet Request Letter
E. ITC FORM 9552-3, Employee Request for MSDS
F. ITC FORM 9552-4, IT Hazardous Chemical Inventory Sheet
G. ITC FORM 9552-5, Request for Approval of a New Hazardous Substance Purchase/Use
H. ITC FORM 9552-6, Training Attendance Record
I. ITC FORM 9552-7, Employee Training Record

3. Stock Hazardous Materials Information System (HMIS) labels and posters for distribution.

4. Request MSDSs from suppliers for new hazardous substances being considered for use in IT and submit to the Regional Health and Safety Office per Section V of this procedure.

D. **Laboratory offices will:**

1. Develop laboratory safety and health plans and programs that include provisions for informing employees on physical hazards, health hazards, safe work practices, and emergency procedures associated with hazardous substances involved.

2. Ensure that laboratory supervision is knowledgeable on hazards and safe work practices for substances used in the laboratory and supply the information to all employees.

3. Maintain MSDS's on those hazardous substances used in the laboratory.

E. **Operations, Engineering and all other offices will:**

1. Provide an inventory on ITC Form 9552-4, "Hazardous Substances Inventory", of hazardous substances being used at each location to their Regional Health and Safety office.

2. Assist in providing information and training to employees through posting of MSDS and labeling information and conducting Tailgate Safety Meetings per ITC PRO 9540.1C.

3. Provide for training of employees on hazardous substances in their work area at the time of their initial assignment, and whenever a new hazard is introduced in the work area.

4. Maintain hazardous substance information in work areas.

5. Provide for notification of IT contractors and their employees of hazardous substances at IT facilities where they are working.

F. **Human Resources**

1. Provide summary information to all new hires on the written hazard communication program and employee rights.

V. NEW HAZARDOUS SUBSTANCE APPROVAL

A. All departments planning to use a new hazardous substance at IT shall submit a "Request for Approval of a New Hazardous Substance Purchase/Use", Form 9552-5, to:

1. Purchasing Office, if the requestor does not have a valid MSDS.

2. Regional Health and Safety Office, if the requestor has a valid MSDS.

VII. MATERIAL SAFETY DATA SHEETS (MSDS)

A. Discussion

Hazardous substances in the workplace in some forms, concentrations, and job activities pose potential acute and/or chronic health hazards to employees who are exposed to these substances.

All employees have a right and a need to know the properties and potential hazards of substances to which they may be exposed, and such knowledge is essential to reducing the incidence and cost of occupational disease and industrial accidents.

OSHA Form 174, Attachment A to this procedure, has entries for all of the information now required by the Federal and Cal OSHA standards. This new form replaces the OSHA Form 20.

ITC MSDS Form 9552.1A includes all of the information required on OSHA Form 174.

ITC Form 9552-2A, "MSDS Request Form Letter", will be used for requesting MSDS's from all suppliers. All new MSDS's will be returned from the suppliers to the Corporate Health and Safety Office for maintenance and distribution as necessary.

Pursuant to the requirements of OSHA regulations to make chemical health and safety information available to employees, this directive prescribes the use of material safety data sheets by area supervisors to provide the required information to affected employees.

B. Definitions for the Purpose of this Directive

1. Acute - an adverse effect on the human body with immediate onset of symptoms.

2. Catalyst - A substance which changes the rate of a chemical reaction between two other chemicals, but undergoes no permanent change itself.

3. Chemical name - The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

4. Chronic - An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

5. Common Name - Means any designation or identification such as code name, code number, trade name, or brand name used to identify a substance other than by its chemical name.

a. The list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes which are applicable to the list shall be understood to modify the same substance on all other source lists or hazard determinations set forth in Sections 8 CAC 5194 (d) (3) (B) and (d) (5) (D).

b. 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA).

c. Threshold Limit Values for Chemical Substances in the Work Environment, American Conference of Governmental Industrial Hygienists (ACGIH), 1984.

d. National Toxicology Program (NTP), Third Annual Report on Carcinogens, 1983.

e. International Agency for Research on Cancer (IARC) Monographs, Vols 1-34.

Note: The Registry of Toxic Effects of Chemical Substances published by the National Institute for Occupational Safety and Health indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

10. Hazardous mixtures - Means any solution or intimate admixture of two or more substances, at least one of which is present as a hazardous substance, as described in 9 above.

A hazardous substance is present in any mixture or product if it is one percent or more of the mixture or product or two percent if the hazardous substance exists as an impurity in the mixture, provided that the state may, by regulation, raise the concentration requirement for a hazardous substance which the state finds is not hazardous at the threshold levels; and, lower the concentration requirement for a hazardous substance for which there is valid and substantial evidence that the substance is extraordinarily hazardous.

11. MSDS - Means a material safety data sheet prepared pursuant to state and federal regulations, OSHA Form 174, Attachment B.

12. Polymerization - A chemical reaction which results in the joining together of two or more like molecules to form a more complex molecule whose molecular weight is a multiple of the original and whose chemical properties are different. Polymerization reactions commonly produce excessive heat and may cause an increase in pressure which requires adequate venting to prevent destructive explosive failure of containers.

13. Reactivity - A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

b. For hazardous substances to which the worker may be exposed, employees shall be informed of their right to access to MSDS's, their right to request MSDS's from their employer for materials they suspect are hazardous, and the right of their representative or physician to obtain such MSDS's.

c. All employees who may be exposed to a hazardous substance shall be given training and information:

(1) Upon a timely and reasonable basis, no later than 30 days after receipt of a new MSDS, or

(2) Prior to assignment of an employee to an area containing a hazardous substance for which previous training has not been received.

d. Subject training and information shall be accomplished by either formal classroom instruction or jobsite Tailgate Safety Meetings in accordance with ITC PRO 9540.1 "Tailgate Safety Meetings."

e. A completed MSDS, when available, or equivalent information, for each hazardous substance or hazardous mixture used or encountered by employees shall be maintained in the workplace and accessible to employees in their work area. This shall include, but is not limited to:

(1) Cleaning agents, such as solvents, detergents, acid inhibitors, etc., used for industrial cleaning;

(2) Hazardous substances or hazardous mixtures contained in the process vessels or equipment being cleaned or otherwise serviced; and

(3) Janitorial and housekeeping substances used by employees at IT facilities.

3. **Information Required on a Material Safety Data Sheet**

a. The name, address, and telephone number of the source of information specified in this paragraph, preferably those of the manufacturer of the product or material.

b. The trade name and synonyms for a mixture of chemicals, a basic structural material, or for a process material the chemical name and synonyms, chemical family and formula for a single chemical.

c. Chemical names of hazardous ingredients, including, but not limited to, those in mixtures, such as those in:

(1) Paints, preservatives, and solvents;

(2) Alloys, metallic coatings, filler metals and their coatings or core fluxes; and

(1) A Master File of MSDSs will be maintained by the Corporate Director, Health, Safety & Training. Copies of the master file inventory will be distributed to Regional Health and Safety Offices.

(2) MSDS Binders shall be maintained locally by area management for materials used at that location.

(3) Copies of MSDSs may be obtained by completing ITC Form 9552-3, "Employee Request for MSDS" (Attachment E), and forwarding it to the Regional Health and Safety office.

VIII. EMPLOYEE INFORMATION AND TRAINING

A. Employees shall be provided with information and training on hazardous substances in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

1. On spills or site remediations of unknown materials, every effort shall be made to categorize the hazard(s) before starting work. Tailgate safety meetings will be used to inform employees of the hazards.

2. Explanations shall be made to employees on what an MSDS is, and of the contents of the MSDS for hazardous substances to which employees may be exposed, or equivalent information, either in written form or through training programs.

3. When training employees on the contents of a MSDS, supervision shall explain any health hazards associated with use of the substance or mixture; proper precautions for handling, necessary personal protective equipment or other safety precautions necessary to prevent or minimize exposure; and emergency procedures for spills, fire, disposal and first aid.

4. When the Regional Health and Safety office receives a new or revised MSDS, such information shall be provided to employees on a timely basis not to exceed 30 days after receipt, if the new information indicates significantly increased risks to, or measures necessary to protect, employee health as compared to those stated on a MSDS previously provided.

B. Employees shall be informed of the right:

1. To personally receive information regarding hazardous substances to which the employee may be exposed. ITC Form 9552-4, "Employee Request for MSDS", shall be used by employees requesting MSDS copies.

2. For their physician or collective bargaining agent to receive information regarding hazardous substances to which the employee may be exposed.

APPENDIX A

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM

(HMIS)

This HMIS is based on a comprehensive system for hazardous materials identification. This system conveys chemical identity by chemical or common names, code numbers, or other descriptive terms which clearly identify the material for hazard information purposes. The acute health, flammability, and reactivity hazards are communicated by numerical ratings inserted onto the label itself. An alphabetical designation is used to denote a combination of proper personal protective equipment. That designation is also inserted onto the label. The Regional Health and Safety Office will provide guidance on what hazard index and what personal protection index should be used.

Hazard Index (HI)

The description of the numerical Hazard Index (HI) and alphabetical Personal Protection Index (PPI) are shown as follows:

4 Severe Hazard
3 Serious Hazard
2 Moderate Hazard
1 Slight Hazard
0 Minimal Hazard

These designations will be inserted (written) with indelible ink by each hazard on the label, i.e., Health, Flammability, Reactivity. That information is obtained from the MSDS or other sources by the Regional Health & Safety Office.

Definitions of Hazard Categories

Health Hazard

4 Danger: May be fatal on short exposure. Specialized protective equipment required.

3 Warning: Corrosive or toxic - avoid skin contact or inhalation.

2 Warning: May be harmful if inhaled or absorbed.

1 Caution: May cause irritation.

0 No unusual hazard.

Colored posters explaining this labeling system will be mounted in areas where chemicals and containers are used.

Employees and supervisors working in those areas where chemicals are used or stored will be given wallet-size cards with Hazard Index and Personal Protection Index for quick reference.

Labels and posters are available from the Purchasing Office.

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

U.S. Department of Labor
Occupational Safety and Health Administration
(Non-Mandatory Form)
Form Approved
OMB No. 1218-0072

IDENTITY *(As Used on Label and List)*	*Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III — Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

Attachment C

Return completed Data Sheet to:
Health & Safety Manager
International Technology Corp.
23456 Hawthorne Blvd.
Torrance, CA 90505

Material Safety Data Sheet

May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.

IDENTITY *(As Used on Label and List)*	*Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III — Physical/Chemical Characteristics

Boiling Point (°F/°C-specify)		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		**Melting Point (°F/°C-specify)**	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

INTERNATIONAL TECHNOLOGY CORPORATION

Gentlemen:

In order that International Technology Corporation can comply with Federal and State Hazard Communication Standards and Right-to-Know Laws, it is necessary that we have the most current hazard information on materials we purchase from you. Please supply us with Material Safety Data Sheets (MSDS's) on the item(s) listed below:

An International Technology Material Safety Data Sheet form 9552-1A is attached for your convenience in replying to our request. If, however, you use your own MSDS form, please make sure that all the information required in our form is included in yours. Please send the completed form(s) to the attention of the Manager of Health and Safety at the address below.

Thank you,

Chain Robbins

M. Chain Robbins
Manager, Health and Safety

MCR/dt
Enclosures

Corporate Headquarters
23456 Hawthorne Boulevard • Torrance, California 90505 • 213-378-9933

APPENDIX Y

SUGGESTED CONTRACTOR'S ACCIDENT PREVENTION PLAN FORMAT

The following guidance is provided for the preparation of contractor accident prevention plans. Failure to provide the required information is likely to result in delayed project start-up or other appropriate action by the designated authority. The accident prevention plan needs to address the following:

a. Administrative Section.

(1) Administrative responsibilities for effecting the Accident Prevention Plan (identification and accountability of Contractor personnel responsible for accident prevention).

(2) Local requirements, if any, which must be complied with; i.e., noise control, traffic problems etc.

(3) Method prime Contractor proposes to control and coordinate work of his Subcontractors.

(4) Plans for layout of temporary construction buildings and facilities, including how Contractor plans to control those of Subcontractors.

(5) Plans for initial indoctrination, continued safety education, and training for the Contractor's employees. (See 01.B. and 01.C.).

(6) Plans for traffic control and marking of hazards to cover haul roads, highway intersections, railroads, utilities, bridges, restricted areas, etc.

(7) Plans for maintaining continued job cleaup, safe access and egress. (See 11.I.14.).

(8) Plans for fire protection and dealing with emergencies (ambulance service, fires, man overboard, etc.). (See sections 4, 6, 11, and 12).

(9) Plans for inspection of the jobsites by competent persons including reports to be kept, results of the inspections, and corrective actions taken. (See 01.A.04.)

APPENDIX Y (CONT)

(10) Procedures to be used for accident investigation. (See 02.A.)

(11) Details of fall protection systems. (See 07.D. and 07.I.)

(12) Description and sketch of temporary power distribution system. (See 15.D.15.).

(13) Description of safe clearance procedures. (See 28.A.).

(14) Description of office trailer anchoring system. (See 06.A.05).

(15) Contingency plans for severe weather; i.e., coastal areas tornado areas, etc.

b. Activity Hazard Analysis Section.

(1) An Activity Hazard Analysis shall be developed for each contract activity and operation occurring in each major phase of work.

(2) The Contractor shall develop the plan to identify the sequence of work, the specific hazards anticipated, and the control measures to be implemented to minimize or eliminate each hazard. The Activity Hazard Analysis shall be job specific and shall address the following major points:

(a) Activity being performed (Identify major phase)

(b) Sequence of work

(c) Hazards to be controlled in each activity

1. ROCKY MOUNTAIN ARSENAL
STANDING OPERATING PROCEDURE FOR:

2. ITEM: EMERGENCY RESPONSE PLAN FOR FIELD ACTIVITY DISCOVERED CHEMICAL AGENTS AT ROCKY MOUNTAIN ARSENAL (RMA)

3.a. OPERATION: EMERGENCY RESPONSE

3.b. ESTIMATED DAILY PRODUCTION RATE: _____

4. ARSENAL ORGANIZATIONAL SYMBOL: SMCRM-SF

5. SOP NO.: SF-50-1 DATE: 25 APRIL 1988

5.a. REV NO.: 1 DATE: 25 APRIL 1988

5.b. CHANGE NO.: _____ DATE: _____

6. AUTHORITY: AMC-R 385-131 AR 50-6 DATE: 9 OCT 1987 12 NOV 1986

7. PREPARED BY: ALMA T. HARRIS TITLE: SAFETY & OCCUPATIONAL HEALTH MANAGER

TELEPHONE: 303-289-0338

8. REVIEWED BY: WILLIAM MOLONEY TITLE: QUALITY ASSURANCE OFFICE

REVIEWED BY: MARTIN L. WITTIG TITLE: CHIEF, FIRE PREVENTION BRANCH

9. SUBMITTED BY: ALMA T. HARRIS TITLE: SAFETY & OCCUPATIONAL HEALTH MANAGER

10. CONCURRENCES:

OFFICE	SIGNATURE	TITLE
SMCRM-IS		DIR, INSTALLATION SERVICES
SMCRM-TS		C, TECHNICAL SUPPORT OFFIC
SMCRM-SS		C, SECURITY OFFICE
SMCRM-ISS		C, SYSTEMS OPERATIONS DIV
AMXRM-TO		PM, TECHNICAL OPERATIONS
TECHNICAL ESCORT UNIT		TEU COMMANDER
SMCRM-ISF		ENVIRONMENTAL COORDINATOR
SMCRM-SF		SAFETY MANAGER

SOP COVER SHEET

SUPERVISOR'S STATEMENT

SOP No. SF-50-1 REV No._____ CHANGE No._____ DATE_____

1. The Supervisor will sign this statement:

   a. When first assigned as supervisor of the operation;

   b. When an approved formal or interim change is made to the SOP;

   c. At least once per quarter during simulation exercises;

2. I have personally reviewed each of the operational steps of this SOP and have no question in my mind that the operation can be performed safely, efficiently, and in an environmentally acceptable manner. I have trained the operators in the details of their part of the operation and have instructed them to follow the SOP without deviation.

SUPERVISOR:

(1)_____	_____	_____	
ECC COMMANDER	DATE	SIGNATURE	
(2)_____	_____	_____	
TEU COMMANDER	DATE	SIGNATURE	
(3)_____	_____	_____	
	DATE	SIGNATURE	
(4)_____	_____	_____	
	DATE	SIGNATURE	
(5)_____	_____	_____	
	DATE	SIGNATURE	
(6)_____	_____	_____	
	DATE	SIGNATURE	
(7)_____	_____	_____	
	DATE	SIGNATURE	
(8)_____	_____	_____	
	DATE	SIGNATURE	

EMERGENCY RESPONSE PLAN FOR FIELD ACTIVITY DISCOVERED CHEMICAL AGENTS

TABLE OF CONTENTS

This SOP supersedes SMCRM-DC, DC-R-50-1, 13 May 87.

2. SCOPE. This SOP outlines the responsibilities for the RMA Emergency Response Team to follow whenever a chemical accident/incident occurs at this installation. This SOP will be added as an Appendix to the contractor's Safety and Health Plans.

3. RESPONSIBILITIES:

a. The Commander (Cdr), RMA, will:

(1) Be in complete command and control of all personnel, equipment, and procedures within the operational site.

(2) Provide appropriate level protective clothing for all emergency response personnel. [The source of supply is the ISSA (Intra Service Support Agreement) with Pueblo Army Depot.]

(3) Designate a Chemical Accident/Incident Response Officer (CAIRO) to conduct actions In Accordance With (IAW) this SOP. (When the Technical Escort Unit (TEU) are here, they will be the CAIRO.)

b. The CAIRO will:

(1) Initiate actions based upon this SOP to limit the spread of contamination and to prevent personnel becoming chemical casualties.

(2) Set up and control operations in and around the site from a mobile Command Post (CP) located upwind of the site at a safe distance based upon the particular circumstances of the accident/incident/occurrence.

(3) Determine the facts regarding the accident/incident/occurrence, and make appropriate recommendations as to response actions needed to the Cdr, RMA. Take actions as approved. In the absence of the Cdr, RMA, take actions considered necessary and appropriate.

(4) Advise and provide operational support to an AMC General Officer (On-Scene Commander) if one arrives at the Installation.

c. The Chief, Fire Department (Dept), RMA, will:

(1) Arrive on-site and assume full responsibility as the Assistant CAIRO (A/CAIRO) until arrival of CAIRO. Accomplish the immediate decontamination/treatment/evacuation of casualties from the site, and limit access onto the site to personnel needed for emergency response actions.

j. The Chief, Systems Operations Division, will:

(1) Provide a trained and knowledgeable personnel decontamination team, comprised of other Arsenal elements, to respond to emergency situations in the event TEU is not available at RMA.

(2) Be the CAIRO when TEU is not available at RMA.

(3) Provide personal protective clothing and equipment to all RMA Emergency Response members.

k. The Contractor's On-Site Safety Officer (OSO) will:

(1) Provide the mini Decon and central shower system for his particular operations.

(2) Ensure that contractor personnel's Site Safety Procedures interface with this Emergency Response SOP.

(3) Ensure provisions are made for some (minimum 2) contractor personnel to remain on site at a predesignated location (at least 50 meters upwind) until RMA or Technical Escort Unit (TEU) emergency response team arrives so that information can be relayed to the emergency response teams.

(4) Ensure proper protective measures are utilized by contractor personnel on each operational site, to include protective clothing worn and removed properly for decontamination; chemical detection equipment and core sample heaters utilized correctly; and all equipment secured on site until site has been cleared by RMA emergency response actions in the event chemical contamination is suspected.

(5) Upon two consecutive positive readings with the M-18A2 during drilling or soil sampling operations, ensure all personnel within 150 feet of the drill/sample site and where the sample was tested move to a predetermined site upwind and thoroughly decontaminate their outer clothing. The RMA Fire Department will be called to initiate an emergency response.

(a) Have the crew immediately transported in a vehicle with a removable bed liner to the contractor support area where they will process through the hot line to the showers. Clothing and equipment will be double-bagged and held; wash water will be retained. Personnel will be observed throughout the process for symptoms of agent exposure.

(9) Ensure radio/telephone contact with CAIRO on site is maintained during all operations.

(10) Ensure that the required personnel, equipment, and decontaminants are on-hand before starting operations.

(11) Be responsible for establishing the hotline.

(12) Ensure that a log (DD Form 1594) of operations is kept.

m. The Decon Team Hot Line Supervisor (TEU NCOIC when on post) will:

(1) Ensure that all personnel are prepared and ready for work upon arrival at the work site at the time designated by the OIC.

(2) Ensure that each individual has been briefed on the hazards of the operations and that the SOP has been read, understood, and signed by all personnel concerned.

(3) Ensure that substitutes for the operational teams are available when required.

(4) Ensure that all operational personnel have received a daily safety briefing before they are involved in any operations.

(5) Ensure that all equipment will be operated by licensed personnel.

(6) Ensure that all downrange personnel have had their protective masks fit checked with amyl acetate (banana oil).

(7) Ensure the CAIRO has TEU radio net and RMA Charlie net, as necessary.

n. The TEU personnel will perform procedures as directed by the OIC.

o. The individual workers will:

(1) Follow protective measures outlined in this SOP and any other applicable SOPs in order to prevent the spread of contamination and to prevent becoming a chemical casualty.

(2) Inform supervisor of any change in health status, particularly during and after operations occur.

4. HAZARDOUS CHEMICALS. In all cases, the RMA Fire Prevention Branch will, after initial decontamination, evacuate the victim immediately to the Fitzsimons Army Medical Center (FAMC) Emergency Room (ER). They will ensure the FAMC ER is notified of the incoming casualty by the most expeditious communication method available.

(3) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty, if necessary.

d. Caustic Soda (Sodium Hydroxide).

(1) Caustic Soda is the primary decontaminant for G series agents.

(2) Caustic Soda should be mixed in an iron or steel container, never in an aluminum one.

(3) Add Caustic Soda to water to prevent boiling and spattering due to the excessive heat emitted.

(4) Caustic Soda can cause skin burns.

(5) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

NOTE: Caustic Soda is not in the list of required materials. Use Soda Ash instead.

e. Nerve Agents (GB, GD, GA, VX).

(1) GB, GD, and GA are colorless liquids with a high boiling point and a very low freezing point. They are considered non-persistent, lethal chemical agents.

(2) VX is a straw-colored liquid with an extremely high boiling point and a very low vapor pressure. It is considered a persistent, lethal chemical agent.

(3) Nerve agents are rapid-acting, lethal chemical agents. The action of the agent within the body is the inactivation or inhibition of cholinesterase. The hazards from nerve agents are that of vapor absorption through the respiratory tract, absorption through any part of the skin, through the eyes, and through the gastrointestinal tract by ingestion.

(4) Accidental skin contact with the liquid agent or inhalation of agent aerosol or vapor are the most common causes of casualties. The agent absorption rate is accelerated through cuts or abrasions in the skin.

(5) Symptoms - Initial:

(a) Pinpointing of pupils (myosis) and dimness of vision.

(b) Running nose.

f. Mustard (H, HD, HT - Blister Agents).

(1) Mustards are oily liquids ranging from colorless to dark brown in color. They have a characteristic odor similar to garlic or horseradish. Mustards freeze at approximately 58 degrees Fahrenheit, are stable in storage to 252 degrees Fahrenheit, and have no action on metals.

(2) Mustards are delayed-action, persistent, toxic chemical agents that burn and blister the skin or injure the internal parts of the body. Main portals of entry into the body are by inhalation of the vapors, by liquid contact with the skin, or through any body opening.

(3) Persistence of the hazard from mustard is dependent upon the concentration of the agent and the temperature. It will persist two to five times longer in the winter than in the summer.

(4) Mustard has a cumulative effect even in small repeated exposures and may produce a sensitization in some individuals. If this occurs, the individual will exhibit allergic symptoms and will react to even small doses.

(5) Symptoms.

(a) Little or no pain occurs upon exposure to mustards. The first symptoms appear 4 to 6 hours later.

(b) Eyes are extremely sensitive to low concentrations of mustard and become inflamed, causing "red eye" and a sensation of grit in the eyes.

(c) When exposed to heavy concentrations, the nose and throat become inflamed, causing the sensation of having a head cold.

(d) The skin reddens and water blisters may develop if the individual contacts liquid mustard.

(6) After exposure to a mustard agent (H, HD, HT, or L), flush eyes and face with copious amounts of fresh water. Blot contamination from the skin - DO NOT RUB OR SCRUB!

(7) Remove the person from the source of the contamination and flush the skin and clothes with a 5% Sodium Hypochlorite solution within one (1) minute of exposure. Remove the contaminated clothing. Flush the skin again with a 5% Sodium Hypochlorite solution. Wash contaminated skin with soap and water. If showering facilities are not immediately available, use the skin decontamination pads found in the M258A1 Decontamination Kit.

(1) Blood agents are absorbed into the body primarily by breathing. They affect the bodily functions through action on the enzyme cytochromeoxidase, thus preventing the normal transfer of oxygen from the blood to the body tissues.

(2) Blood agents are rapid acting casualty-producing agents which have a short duration of effectiveness due to the high volatility of the agents.

(3) CK has the additional capability of breaking down the filter elements of the protective mask.

(4) Symptoms:

(a) Increased breathing rate. (AC) Rapid or shallow breathing, depending on type.

(b) Decreased breathing rate. (CK).

(c) Increased pulse rate and pounding heart.

(d) Lips and skin will flush pink to red because of the excessive oxygen in the blood.

(5) After exposure to a blood agent, evacuate the casualty immediately to the FAMC ER.

(6) Artificial respiration may be needed if breathing becomes difficult.

(7) Decontamination procedures for AC and CK is to wash with copious amounts of water. However, the agent has a rapid evaporation factor making field decon ineffective.

(8) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

i. Adamsite (DM - Vomiting Agent).

(1) DM is a greenish--yellow powder to black solid with no apparent odor.

(2) DM has a very high rate of action and requires only about one (1) minute to incapacitate an individual.

(3) Symptoms:

(a) Irritation to the eyes and mucous membranes.

(b) Runny nose.

(2) Sypmtoms: (after 1 to 4 hours).

(a) Restlessness.

(b) Dizziness.

(c) Confusion.

(d.) Vomiting.

(e) Dryness of the mouth.

(f) High temperature (sometimes above 102° F *, p. 6)

(g) Flushing of the skin.

(h) Blurred vision.

(i) Dilation of the pupils.

(j) Slurred speech.

(3) After exposure to an incapacitating agent, keep the casualty calm, restrained; may need cooling as for heat stroke*.

(4) Decontamination of personnel can be accomplished by washing contaminated parts with soap and water. Flush eyes with clear water only. Clothing and individual equipment should be shaken or brushed and thoroughly washed. Hypochlorite or alcohol caustic solutions are suitable for deconning.

(5) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

1. White Phosphorous (WP) and Red Phosphorous (RP).

(1) WP and RP are bursting smokes which ignite spontaneously when they come in contact with air. The vapors of WP and RP are poisonous, and exposure causes bone decay. (No vapors are found in smoke.)

(2) WP and RP should be moved and stored under water to prevent spontaneous combustion.

(3) Symptom: Severe burns which could take a long time to heal.

(4) After exposure to WP or RP, keep the casualty calm and keep the affected area under water.

(5) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

SOP No. SF-50-1 DATE 25 Apr 88
Rev No. 1 DATE 25 Apr 88
CHANGE _____ DATE _____

6. INDEX OF OPERATIONS

REMARKS:

a. This SOP prescribes policies and procedures for emergency response actions to be taken at Rocky Mountain Arsenal (RMA). These emergency response actions will support drilling and sampling operations conducted by government and contractor personnel; liquid sampling and area clearance operations conducted by Technical Escort/Explosive Ordinance Detachment (TEU/EOD) personnel; and any other future operations conducted at RMA in which potential for exposure to a chemical surety material exists.

b. The majority of contractors physically working on RMA are supporting the Remedial Investigation (RI) being conducted by the Program Manager for Contamination Cleanup, RMA. The two primary contractors are EBASCO and ESE. Both contractors are involved in drilling soil samples and pulling water samples from the thousands of wells located on RMA.

(1) Morrison-Knudsen Engineers is one of the contractors conducting an RI of contamination on RMA for Shell Chemical Company. This firm does its own collection of soil and water samples, as well as receiving splits of samples taken on RMA by EBASCO and ESE.

(2) Each contractor has numerous subcontractors who fulfill some portion of their contracts on RMA. The contractors, as well as their subcontractors, are responsible for adhering to the procedures outlined in this SOP for the health and safety of all concerned.

c. The Program Manager is responsible for the overall health and safety of contractors working for them. Any changes made by contractors which may affect the health and safety of their employees should be coordinated with the Program Manager and the RMA Safety Manager.

A. STANDING OPERATING PROCEDURE FOR Emergency Response by Rocky Mountain Arsenal (RMA) Personnel and TEU/EOD Personnel (when on post)

B. OPERATION 1
C. LOCATION RMA
D. SOP No. RM-SF-50-1 DATE 25 Apr 88
E. REV No. 1 DATE 25 Apr 88
F. CHANGE No. ___ DATE ___

G. OPERATION: Sampling and/or Area Sweeps

H. EXPLOSIVES LIMITS: N/A

I. PERSONNEL LIMITS: Available Personnel on the current TDA

J. STEP NO./DESCRIPTION	SPECIFIC INSTRUCTIONS (Safety (S), Operational (O), Quality Checks (QC))
1. Pre-Operation & During Operation. The supervisor of each operational site will ensure actions are IAW approved SOPs and Safety Plans.	1 (O). OSO/OIC will designate the location of the CP at least 50 meters upwind of the operational site, and will relocate the CP as needed. 2 (O). OSO/OIC will establish and maintain telephone and/or radio communications with the RMA Fire Dept. 3 (QC). OSO/OIC will appoint a CP recorder who will maintain a daily log of all operations to be given to the CAIRO if emergency response actions become necessary. 4 (S). Personnel should know the proper protective equipment to be worn, the proper decontamination techniques to be performed, the methods to limit the spread of potential contamination, and the actions to be taken upon finding a positive test for chemical surety material.

NOTE: Personal Protective Clothing & Equipment (PPC&E) can be found in paragraphs K and L. Levels of PPC&E can be found in AMC-R 385-1, Chapter 4.

J. STEP NO./DESCRIPTION	Specific Instructions (Safety(S), Operational(O), Quality Checks(QC))
b. These actions will be a combined RMA-TEU response to any notification of a positive reading for chemical surety material.	the CP at the operational site to initiate measures to limit access to the area to authorized personnel only and to assume duties as the A/CAIRO. 3 (S). Until appropriate monitoring with an M18A2 kit has proven the initial test negative, all personnel will assume that the chemical agent is present and dress/perform accordingly. 4 (O). Upon arrival on-site, the QA monitoring team will coordinate with the A/CAIRO and the On-Site Safety Officer (OSO) to gather information before proceeding along with the A/CAIRO in appropriate level Protective Clothing onto the site to perform monitoring of samples, equipment, and bore holes. After providing the necessary information [Figure 3], and answering any additional questions, the OSO and any other contractor personnel will process off the site IAW paragraph 2k, page 10. Individuals will be observed closely for signs/symptoms of chemical agent exposure for at least 30 minutes after coming off-site prior to departing RMA for the day. 5 (O). If M18A2 tests by the Monitoring Team prove to be negative, the Monitoring Team will notify the A/CAIRO who will give the OSO permission to resume operations.
4. When TEU/EOD are on post they will contain hazards and establish a hot-line and PDS. They will also take samples for the Lab test.	6 (O). If the M18A2 kit tests prove to be positive for a chemical surety agent, the Monitoring Team will notify the A/CAIRO of the results and the agent present. The A/CAIRO will direct the personnel decontamition team to set up a PDS, notify the OSO of the positive test results for that particular chemical surety agent.

J. STEP NO./DESCRIPTION	Specific Instructions (Safety(S), Operational(O), Quality Checks (QC))
	3 (O). The ECC members will proceed to the ECC to assume duties as assigned.
	4 (O). The CAIRO will proceed to the site with the ambulance and driver/ EMT.
	5 (O). The ECC will notify the Lab of possible incoming surety samples, and will notify members of the personnel decontamination team to respond IAW this SOP. He will notify the Downwind Vapor Hazard Calculator to proceed to the (ECC) to begin calculating the DWVHD for the chemical agent identified on site.
	6 (O). The Chief, Security Office, will dispatch a TCP Security Team to the operational site based upon the route of ingress onto the site provided by the A/CAIRO. The A/CAIRO will brief the TCP Security Team upon arrival on-site, and will direct the placement of the TCP based upon wind direction, suspected agent, and routes into and out of the operational area. The Chief, Security Office, then proceeds to the ECC to coordinate security operations on post.
	7 (O). The A/CAIRO will direct the required response level of EMT and FF/RS teams based upon circumstances on-site.
	8 (S). Once on-site, all Emergency Response personnel will remain at the CP designated, unless specifically directed to accomplish emergency rescue procedures downrange either while wearing Level A Protective Clothing or appropriate firefighting protective clothing and respiratory apparatus.

J. STEP NO./DESCRIPTION	Specific Instructions (Safety(S), Operational(O), Quality Checks(QC))
	exposed, and the decontaminants used, by the most expeditious communications method available.
	15 (O). Once the site has been properly marked and all double-bagged protective clothing, contaminated soil, and equipment have been removed, the CAIRO will cancel the emergency response and allow all personnel to return to normal duties.
6. Follow-Up Requirements	1 (O). The Monitoring Team will monitor the double-bagged equipment with a minimum of one (1) each 2 to 3 hour lab bubbler to determine if contamination is present.
	2 (O). If the analyses show the equipment is no longer contaminated, it can be released to contractor personnel for use <u>on RMA only</u> since it will have been decontaminated to 3X level only. If the analyses show the equipment is still contaminated, the monitoring team will attempt to decontaminate and bubble the equipment again. If the equipment is still contaminated, the equipment will be held on RMA for future thermal decontamination.
	3 (O). Once the analyses of the samples are completed, the RMA Lab will furnish results to QA, Cdr, RMA, TEU (when on post), PM, and the contractor involved. If there are no detectable levels of chemical surety material present in the sample, it can be released to the contractor, and from the contractor to all other appropriate contractors/subcontractors. If there are detectable levels of chemical surety material present within the sample, the sample will not be released, and will remain in Building 882 until final disposal after approved decontamination.

K. SPECIAL REQUIREMENTS:

1. Equipment will be added or deleted as dictated by the situation and/or weather conditions at the discretion of the OIC/NCOIC/CAIRO.

2. First Aid Equipment: (located in the ambulance provided by RMA):

a.	Stretcher	2 ea
b.	Blanket, Wool	4 ea
c.	Water	5 gal
d.	Kit, First Aid, General	2 ea
e.	NAAK, Mark 1	6 ea

L. EQUIPMENT, TOOLS, GAGES, AND SUPPLIES:

	ITEM	QTY
1.	MATERIALS:	
a.	HTH (Calcium Hypochlorite)	350 lbs.
b.	Soda Ash (Sodium Carbonate - Washing Soda	350 lbs.
c.	Potable Water	20 gals.
d.	Household Bleach (Sodium Hypochlorite -5% Solution)	5 gals.
e.	STB	50 lbs.
2.	TOOLS/EQUIPMENT PER INDIVIDUAL:	
a.	Mask, Protective, M17A2	1 ea
b.	Mask, Protective, M9A1	1 ea
c.	Boots, Safety or TAP	1 pr
d.	Field Jacket or Parka, Cold Weather	1 ea
e.	Gloves, Butyl Rubber	1 pr
f.	Coveralls, Explosive Handler	1 ea
g.	Headgear	1 ea

s.	Kit, Decontamination, Personal, M258A1	2 ea
t.	Brush, Toilet	2 ea
u.	Magic Markers	4 ea
v.	POP (Plaster of Paris)	10 rls
5.	MISCELLANEOUS:	
a.	Radio, Portable	6 ea
b.	Megaphone	2 ea
c.	Air Horn	2 ea
d.	Tape, Surveyors, Plastic	8 rls
e.	Stakes (2" x 1" x 4')	100 ea
f.	Hammer	2 ea
g.	Kit, Detector, M18A2	3 ea
h.	Probes, Non-Metallic	2 ea
i.	EOD Response Kit	1 ea
j.	Sand Bags (Prefilled)	20 ea
k.	.50 Cal Carts, Electric	10 ea
l.	Film, Color 5 x 7	10 pkg
m.	Camera, Polaroid	1 ea
n.	Prop Charge Cans Assorted Sizes (1-8" Prop Charge Can)	
o.	Fluorescent Orange Plastic Strips 1" x 6"	100 ea
p.	Chemical Agent Contamination Markers	50 ea

FIGURE 1

EMERGENCY PERSONNEL DECONTAMINATION STATION (EPDS)

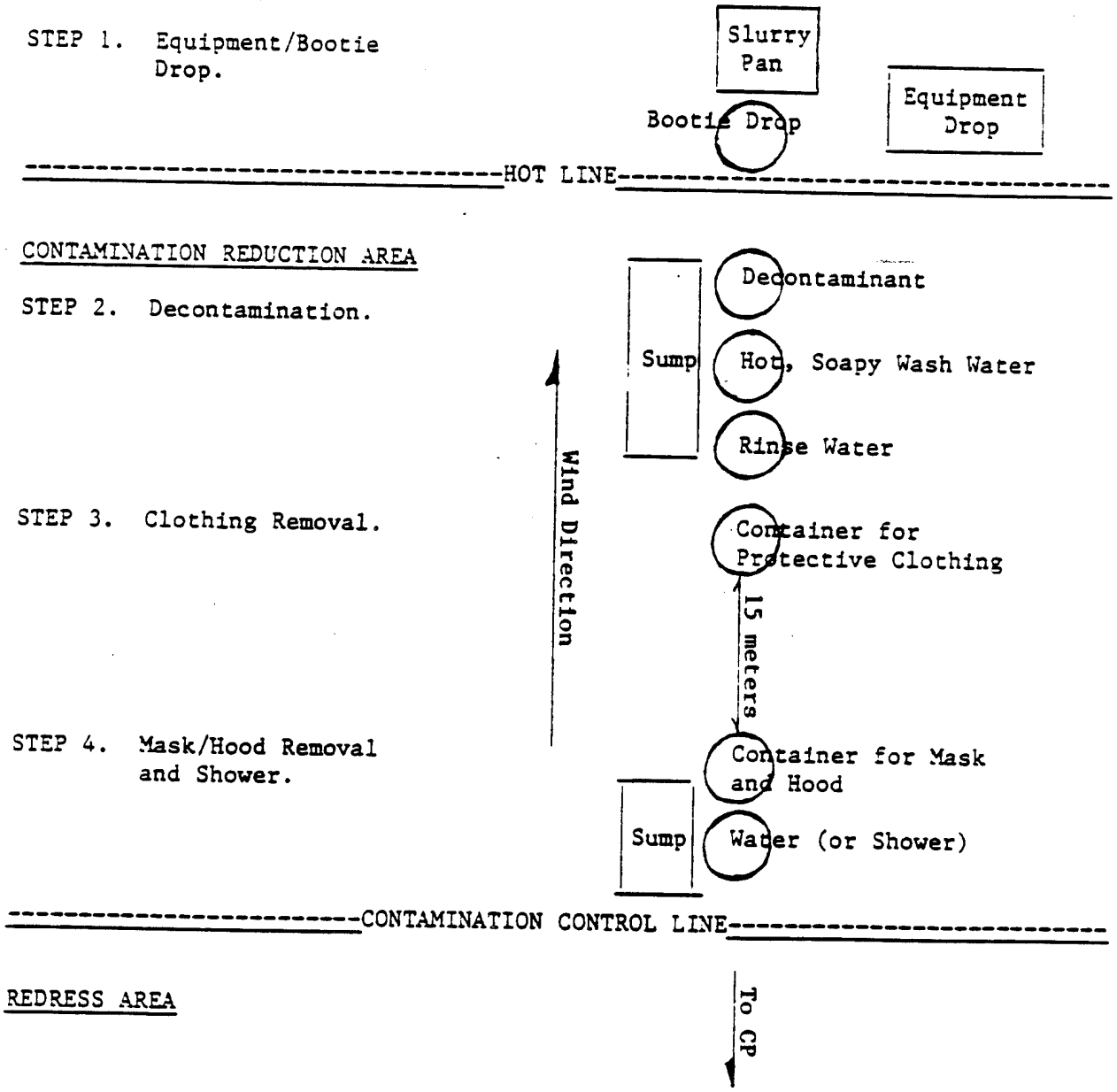

FIGURE 3

RMA FIELD RECONNAISSANCE AND MONITORING
FOR SUSPECTED CHEMICAL AGENT

Date & Time of Investigation: _____

Date & Time of Detection by Contractor: _____

RMA Personnel Conducting Field Investigation: _____

_____

_____

Describe Activities, Protective Clothing, Instruments, and Equipment:

_____

_____

Describe Monitoring Performed at Site: _____

_____

_____

Describe Observations and Action Taken: _____

_____

_____

Conclusion:

_____No Agent Found, Resume Operations.
_____Agent Found, Decontaminated, Resume Operations.
_____Agent Found, Area Isolated, No Further Operations.

Signature of TEU-OIC _____

Signature of Contractor OSO _____

Signature of CAIRO/A/CAIRO _____

UNITED STATES ARMY ACCIDENT INVESTIGATION REPORT

NOTE: SPACES, BELOW, DEFINED BY HEAVY LINES ARE FOR "SAFETY CENTER USE ONLY."

1. UNIT IDENTIFICATION — a. UIC; b. DESCRIPTION
2. TIME AND DATE OF ACCIDENT — a. YEAR; b. MONTH; c. DAY; d. HOUR
3. TIME OF DAY — ☐ a. DAWN ☐ b. DAY ☐ c. DUSK ☐ d. NIGHT
4. LOCATION — ☐ a. ON-POST ☐ b. OFF-POST
5. EXACT LOCATION OF ACCIDENT

SECTION A – PERSONNEL INVOLVED

6. NAME (Last - First - MI)
7. ADDRESS
8. SOCIAL SECURITY NUMBER
9. GRADE
10. AGE
11. SEX — ☐ a. MALE ☐ b. FEMALE
12. MOS OR CIVILIAN JOB SERIES
13. FLIGHT STATUS — ☐ a. YES ☐ b. NO
14. DUTY STATUS — ☐ a. ON DUTY ☐ b. OFF DUTY
15. NO. OF HOURS ON CONTINUOUS DUTY BEFORE ACCIDENT
16. NO. OF HOURS SLEEP IN LAST 24 HOURS
17. CLASSIFICATION AT TIME OF ACCIDENT — ☐ a. ACTIVE ARMY ☐ b. ARMY CIVILIAN ☐ c. ARMY CONTRACTOR ☐ d. NONAPPROPRIATED FUND ☐ e. OTHER U.S. MILITARY ☐ f. ROTC ☐ g. DEPENDENT; NATIONAL GUARD: ☐ TECH ☐ IDT ☐ AT ☐ FTTD ☐ FTM ☐ ADT; ARMY RESERVE: ☐ IDT ☐ AT ☐ ADT ☐ FTM; FOREIGN NATIONAL: ☐ DIRECT HIRE ☐ CONTRACT HIRE ☐ KATUSA; ☐ OTHER
18. THIS PERSON'S ACTIVITY/TASK AT TIME OF ACCIDENT
19. IF THIS PERSON'S ACTIVITY WAS NECESSARY PART OF TRAINING, GIVE TYPE — ☐ a. BASIC ☐ b. PROFICIENCY ☐ c. ADVANCED ☐ d. OTHER ☐ e. OJT
20. WAS THIS PERSON'S ACTIVITY PART OF FIELD EXERCISE? — ☐ a. YES ☐ b. NO
21. WAS THIS PERSON'S ACTIVITY PART OF TACTICAL TRAINING? — ☐ a. YES ☐ b. NO
22. OPERATIONAL CATEGORY
23. SEVERITY OF INJURY TO THIS PERSON — ☐ a. FATAL ☐ b. PERMANENT TOTAL DISABILITY ☐ c. PERMANENT PARTIAL DISABILITY ☐ d. LOST WORKDAY CASE - DAYS AWAY FROM WORK ☐ e. LOST WORKDAY CASE - RESTRICTED WORK ACTIVITY ☐ f. NONFATAL CASE WITHOUT LOST WORKDAYS ☐ g. FIRST AID ONLY ☐ h. NO INJURY ☐ i. MISSING AND PRESUMED DEAD
24. WORKDAYS LOST
25. WORKDAYS RESTRICTED
26. TYPE/NATURE OF INJURY/OCCUPATIONAL ILLNESS
27. BODY PART AFFECTED
28. CAUSE OF INJURY/OCCUPATIONAL ILLNESS
29. VEHICLE RESTRAINT SYSTEM — ☐ a. USED ☐ b. NOT AVAILABLE ☐ c. NOT APPLICABLE ☐ d. AVAILABLE BUT NOT USED
30. THIS PERSON'S ERRORS WHICH CAUSED OR CONTRIBUTED TO THE ACCIDENT

SECTION B – PROPERTY AND/OR MATERIEL INVOLVED

31. LIST ALL PROPERTY INVOLVED IN THE ACCIDENT, WHETHER DAMAGED OR NOT. IF ACCIDENT INVOLVED ARMY OPERATIONS, SHOW COST OF ANY DAMAGE.

NO.	a. NAME OF ITEM		b. OWNERSHIP		c. AMOUNT OF DAMAGE
1					
2					
3					

32. MATERIEL FAILURE(S)/MALFUNCTION(S) WHICH CAUSED OR CONTRIBUTED TO THE ACCIDENT
33. CONTROL NUMBER FOR THE EIR COVERING EACH FAILURE/MALFUNCTION

SECTION C – ENVIRONMENTAL CONDITIONS INVOLVED

34. ENVIRONMENTAL CONDITION(S) WHICH CAUSED OR CONTRIBUTED TO THE ACCIDENT

SECTION D – DESCRIPTION AND CORRECTIVE ACTION

35. FULLY DESCRIBE THE ACCIDENT
36. ACTION TAKEN, ANTICIPATED, OR RECOMMENDED TO CORRECT THE CAUSE(S) OF THIS ACCIDENT
37. SIGNATURE OF COMMAND REPRESENTATIVE
38. COMMAND REVIEW — a. b. c.

SAFETY STAFF USE ONLY

39. REPORT SUBMISSION — ☐ a. INITIAL ☐ b. CHANGE
40. MACOM
41. LOCAL REPORT NUMBER
42. ACCIDENT TYPE
43. TYPE OF VEHICLE COLLISION
44. SAFETY STAFF POINT OF CONTACT
45. SPECIAL REQUIREMENTS
46. DATE REPORT COMPLETED (YY - Mo - Day)

DA FORM 285 — EDITION OF 1 JAN 71 IS OBSOLETE

APPENDIX B

DEPARTMENT OF THE ARMY
ROCKY MOUNTAIN ARSENAL
COMMERCE CITY, COLORADO 80022-2180

REPLY TO ATTENTION OF:

SMCRM-SF 18 May 1988

SUBJECT: Command Policy Letter: Control of Suspected Munitions or Other Hazardous Material Found on Post

SEE DISTRIBUTION

1. All potentially hazardous munitions, munition components, and sensitive or hazardous materials will be controlled from the time of discovery on the Installation until their final disposition. Accountability will be maintained by the Director of Installation Services. Quantities issued to other activities will be controlled by the appropriate responsible officer, who will maintain adequate records to show disposition at all times. All such material will be stored in accordance with current regulations.

2. Any suspected munition or hazardous material found on the Installation will not be moved or handled by the person(s) discovering the suspect item. The location will be noted and the finder's supervisor or foreman will be advised immediately. The following information will be provided:

a. Name of individual discovering item.

b. Location and telephone number of supervisor (foreman) calling.

c. Description of munition or hazardous material found.

d. Specific location of the item(s).

e. Brief description of how the munition or hazardous material was located.

3. Responsibilities:

a. Supervisor (of the individual finding the suspect item) will:

(1) Immediately notify the Chief, Security Office, Extension 367/Fire Prevention Branch, Extension 192, of the finding.

(2) Fill in the initial information (Section A) of the DA Form 3265-R (sample attached) and give to EOD personnel for completion of Section B (or C, Fire Prevention Branch, if EOD is not called in).

This letter supersedes letter, SMCRM-SF, 11 March 1986.

EXPLOSIVE ORDNANCE INCIDENT REPORT

For use of this form, see FM 9-15 and 9-16; the proponent agency is U.S. Continental Army Command.

1. UNIT NUMBER	2. CONTROL NUMBER	3. UNUSUAL	4. ROUTINE
SMCRM-		X	

SECTION A: INITIAL INFORMATION

5. DATE/TIME REPORTED	9. INCIDENT LOCATION	11. ITEM(S) REPORTED
10 Jan 86, 0930 hrs	In back of Bldg 109 North side	Green ton container appears to be bent in in the middle
6. REPORTED BY U. R. Safe		
7. PHONE NUMBER 289-0001	10. WHO TO CONTACT Security Police, X-369 Fire Prev Br, X-192	
8. ADDRESS Rocky Mountain Arsenal		

SECTION B: ACTION BY EOD

12. PERSONNEL DISPATCHED	13. DATE/TIME	14. TRAVEL DATA	15. MAN-HOURS
	A. DPRT	A. AIR-FLYING TIME	A. TRAVEL
	B. ARR	B. VEH-MILEAGE	B. INCIDENT
	C. COMPL		

16. CONFIRMED IDENTIFICATION	17. DISPOSITION

18. INCIDENT NARRATIVE (INCLUDE ALL SIGNIFICANT DETAILS AND PROBLEMS)

19. AUTHENTICATION

A. TYPED NAME, GRADE OF UNIT COMMANDER	B. TELEPHONE NO.	C. DATE

Emergency Response Personnel List (continued)

Decon Team	TEU/EOD Personnel when on post), Ext. 424
TEU/EOD Project Officer	Susan Neary, CPT, Ext. 424
TEU NCOIC, Aberdeen, MD	AV 584-4383
94th EOD, Fort Carson, CO	AV 691-4242
Surety Officer, AMCCOM, (MAJ Calvin Austin)	AV 793-4815
Alternate Surety Officer, AMCCOM (Betty Peterson)	AV 793-3193

(e) After exposure to lead, irrigate eyes with water.

(f) Flush skin with soap and water.

(g) If exposure is respiratory, move the exposed person to fresh air at once and perform artificial respiration.

(h) If the chemical has been swallowed, give large quantities of water and induce vomiting. WARNING: DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT.

(i) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

2. Mercury (Hg).

(a) Mercury is a silvery, mobile, odorless liquid. It boils at 356 - 357 degrees Centigrade. Its vapor pressure at 20 degrees Centigrade is 0.0012 mmHg.

(b) The routes of exposure are inhalation of mercury vapor, skin absorption, and skin and eye contact. Mercury exposure can cause skin and eye irritation. Mercury exposure can also causepneumonitis and bronchitis. Exposure also can cause central nervous system damage and kidney damage.

(c) Symptoms:

(1) Weakness.

(2) Fatigue.

(3) Loss of appetite.

(4) Insomnia.

(5) Loss of weight.

(6) Indigestion.

(7) Diarrhea.

(8) Metallic taste in mouth.

(9) Increased salivation.

(10) Inflammation of gums.

(11) Black line on gums.

(12) Loosening of teeth.

(13) Irritability.

(14) Loss of memory.

(15) Excitability.

(16) Anxiety.

(17) Delirium w/hallucinations.

(18) Melancholia.

(19) Manic depressive psychosis.

(d) If mercury contacts the eyes, irrigate immediately.

(e) If mercury contacts the skin, wash with soap and water promptly.

(f) If exposure is respiratory, move the exposed person to fresh air at once and perform artificial respiration.

(g) If mercury is swallowed, give large quantities of water and induce vomiting. WARNING: DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT.

(h) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

3. Arsenic (As).

(a) Arsenic is a semi-metallic element. The poisonous, whitish, or steel-grey powder of white oxide of arsenic is insoluble in water. Arsenic is present as an impurity in many metal ores and is generally produced as arsenic trioxide as a by-product in smelting of these ores, particularly copper.

(b) The primary routes of entry into the body are skin absorption and ingestion.

(c) Symptoms:

(1) Conjunctivitis.

(2) Visual disturbances.

(f) After inhalation of DBCP vapors, move the exposed person into fresh air at once.

(g) After ingestion of DBCP, give large quantities of water and induce vomiting. WARNING: DO NOT MAKE AN UNCONSCIOUS PERSON VOMIT.

(h) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

5. Chlorinated Pesticides (e.g., Dieldrin and Aldrin).

(a) Chlorinated Pesticides are colorless to light-tan solids with a mild chemical odor, melting at from 175 degrees to 176 degrees Centigrade. These are man-made compounds belonging to the group of cyclodiene insecticides and a subgroup of the chlorinated cyclic hydrocarbine insecticides, including DDT, BHC, etc.

(b) These chemicals are persistent in the environment due to low volatility and low solubility in water. They are extremely apolar, resulting in a high affinity for fat leading to a progressive accumulation in the food chain.

(c) The Federal limit of exposure in 0.25 mg/m3. The STEL value is 0.75 mg/m3, and the IDLH level is 450 mg/m3.

(d) The main routes of entry into the body include inhalation, ingestion, skin absorption, eye and skin contact. The target organs are the central nervous system, liver, kidney, and skin.

(e) Symptoms:

(1) Headaches.

(2) Dizziness.

(3) Nausea.

(4) Vomiting.

(5) Malaise.

(6) Sweating.

(7) Myclonic limjerks (voluntary muscle twitching).

(8) Clonic or tonic convulsions (involuntary muscle).

(9) Coma.

(f) Wash skin with soap and water promptly.

(g) If exposure is respiratory, move the casualty into fresh air at once and perform artificial respiration.

(h) If exposure is by ingestion, get medical attention. WARNING: DO NOT INDUCE VOMITING.

(i) Transport the casualty immediately to the FAMC ER. Notify the ER of the incoming casualty.

7. Unexploded Ordnance (UXO).

(a) The operational area may contain UXOs filled with high explosives and/or chemical agents.

(b) UXOs will be disposed of only by qualified EOD personnel IAW paragraph 7f, SOP TEU-RMA 50-11.

88189R05*
NON-DOJ REVIEWED
2nd COPY

INTERNATIONAL TECHNOLOGY CORPORATION

Project No. 301159
June 1988

SHERP

Phase I Site Investigation and Analysis
Basin F Ground Water Treatment
Interim Response Action
Contract No. DACW45-88-D-0008

Rocky Mountain Arsenal
Commerce City, Colorado

Prepared for:

Department of the Army
Corps of Engineers, Omaha District
Omaha, Nebraska

RESPONSIVE TO THE NEEDS OF ENVIRONMENTAL MANAGEMENT

June 29, 1988
301159

ADDENDUM I
SHERP Phase I Site Investigation and Analysis
Basin F Ground Water Treatment Interim Response Action
Contract No. DACW 45-88-D-0008

The following is additional clarification and explanation of the IT air monitoring program to be utilized at the Rocky Mountain Arsenal.

I. Site Survey

The EHSO will perform a survey of the site using a photoionization detector (PID). This survey will be performed prior to the commencement of work. The data will be recorded and used as baseline data for the site.

II. Daily Monitoring

A sweep survey of the site using the PID will be performed by the EHSO or Field Manager. All data collected during the sweep will be recorded. Readings above 10 ppm will signify that Level C protective clothing and equipment will be worn.

Readings will be taken at a minimum once an hour and recorded. If readings are taken more than once an hour, an average of the readings will be recorded. Any reading above 1 ppm that is obtained will be recorded regardless of the monitoring frequency.

Readings will be taken at the beginning of each new task or when work locations change. All readings will be recorded. Readings above 10 ppm will signify that Level C protective clothing and equipment will be worn.

III. Random Surveys

The EHSO may take random surveys during site visits and audits. All data will be recorded. Any employee on site may perform a survey using the PID should they feel that conditions warrant it. All readings will be recorded and submitted to the Field Manager.

IV. Review of Data

All data collected will be submitted to the Field Manager for initial review. The Field Manager will notify the EHSO of any readings obtained that are greater than 5 ppm above background. All data will be submitted to the EHSO on a weekly basis for review.

V. Coordination with Basin F Activities

The Field Manager will be responsible for checking in with the EBASCO/IT security each date that we are on site. A system will be set up with EBASCO/IT that should they obtain any significant air monitoring readings, we will be notified immediately and thus can implement necessary measures for personnel protection.